PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

INPUT

ABOUT INPUT

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have nearly 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

OFFICES

Headquarters
2471 East Bayshore Road
Suite 600
Palo Alto, California 94303
(415) 493-1600
Telex 171407

Boston
Six New England Executive Park
Suite 400
Burlington, Massachusetts 01803
(617) 273-1156

Dallas
Campbell Center II
8150 N. Central Expressway
Dallas, Texas 75206
(214) 691-8565

Detroit
340 N. Main Street
Suite 204
Plymouth, Michigan 48170
(313) 459-8730

Los Angeles
4676 Admiralty Way
#401 C
Marina Del Rey, California 90291
(213) 823-1230

New York
Park 80 Plaza West-I
Saddle Brook, New Jersey 07662
(201) 368-9471

Washington, D.C.
1730 North Lynn Street
Suite 400
Arlington, Virginia 22209
(703) 522-2118

UNITED KINGDOM
INPUT, Ltd.
Airwork House (4th Floor)
35 Piccadilly
London, W.1.
England
01-439-4442
Telex 269776

JAPAN
INPUT Japan
Suite 1106
7-7-26 Nishi-Shinjuku
Tokyo
Japan 160
(03) 371-3082

AFFILIATES

Australia
Infocom Australia
Highland Centre, 7-9 Merriwa St.,
P.O. Box 110,
Gordon N.S.W. 2072
(02) 498-8199
Telex AA 24434

Italy
PGP Sistema SRL
20127 Milano
Via Soperga 36
Italy
Milan 284-2850

INPUT Planning Services for Management

PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

ABSTRACT

This Impact Report examines the current status of performance measurement and capacity planning within a management-oriented, conceptual framework. The current and future importance and role of performance measurement and capacity planning for MIS organizations are described and assessed. Detailed recommendations are provided for ensuring effective performance measurement and capacity planning. An appendix of available tools is also provided.

U-SPE-100
June 1981
INPUT

000111

PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

JUNE 1981

Digitized by the Internet Archive
in 2015

https://archive.org/details/performancemeasu100unse_0

PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

TABLE OF CONTENTS

©1981 by INPUT. Reproduction Prohibited.

©1981 by INPUT. Reproduction Prohibited.

PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

LIST OF EXHIBITS

©1981 by INPUT. Reproduction Prohibited.

©1981 by INPUT. Reproduction Prohibited.

1 INTRODUCTION

I INTRODUCTION

- Performance measurement and capacity planning are becoming more important to MIS management as well as to general management.

  - This subject was among those gathering the most interest at INPUT's 1980 conference of MIS executives.

  - There have even been perceptive references in the general business press to the issues involved (e.g., a December 1980 article in Business Week).

- Because of this interest, as well as the inherent importance of the subject and recent developments which strongly affect how well it can be done, INPUT has devoted this Impact Report to performance measurement and capacity planning.

- INPUT conducted 43 interviews in February and March 1981 to ascertain:

  - The current status of performance measurement and capacity planning.

  - Issues and problems.

  - Unmet needs and likely future developments.

  - Current and future products to support these functions.

©1981 by INPUT. Reproduction Prohibited.

- Appendices A through C contain the detailed methodology employed and the interview guides used.

- Many of the data are presented in quantitative form. However, qualitative judgments based upon observations made in the course of the research have been introduced where these were seen to be important.

- Several vendor representatives and others with extensive experience kindly shared their experience and observations. While this information could usually not be quantified, it provided a valuable means of cross-checking the findings of the survey and provided additional illustrations and insights.

- During the research numerous examples of good and bad practice were encountered or described. These have been incorporated into the study's recommendations.

©1981 by INPUT. Reproduction Prohibited.

EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

- Performance measurement and capacity planning are made up of interrelated components, as shown in Exhibit II-1. Two of these components stand out as particularly critical to the performance measurement and capacity planning process:

  - Reporting actual versus planned performance is critical for effective capacity planning.

  - Capacity planning must be based upon the business-motivated requirements of computer users.

- Performance measurement and capacity planning have become increasingly important in the last several years. There will be further pressure to improve as a result of the factors shown in Exhibit II-2.

  - Computer systems are becoming more important to many firms.

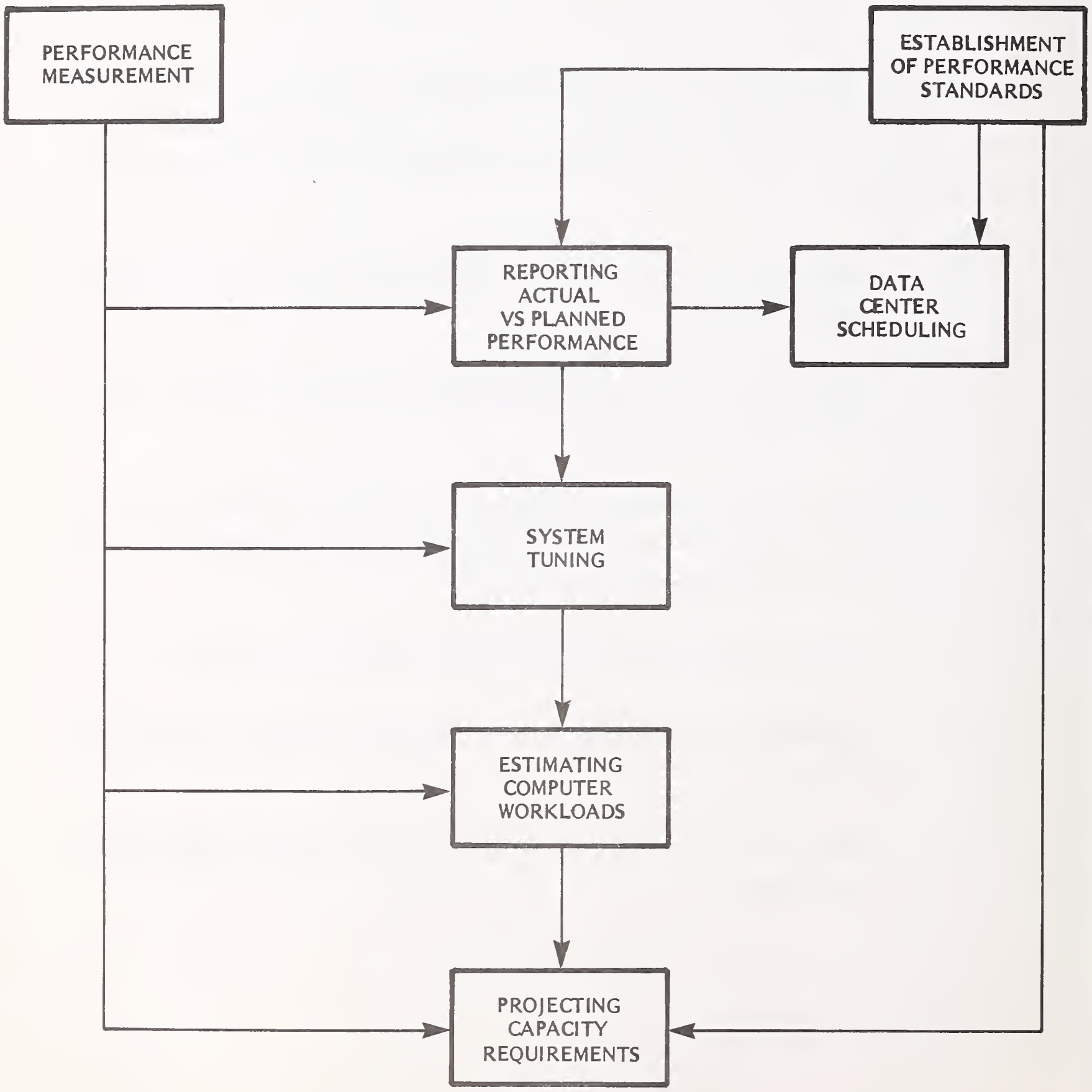
  - Accessibility (i.e., response and turnaround times) is increasingly critical.

  - Many of the factors which increase the need for planning also increase its complexity.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT II-1

COMPONENTS OF PERFORMANCE
MEASUREMENT AND CAPACITY PLANNING

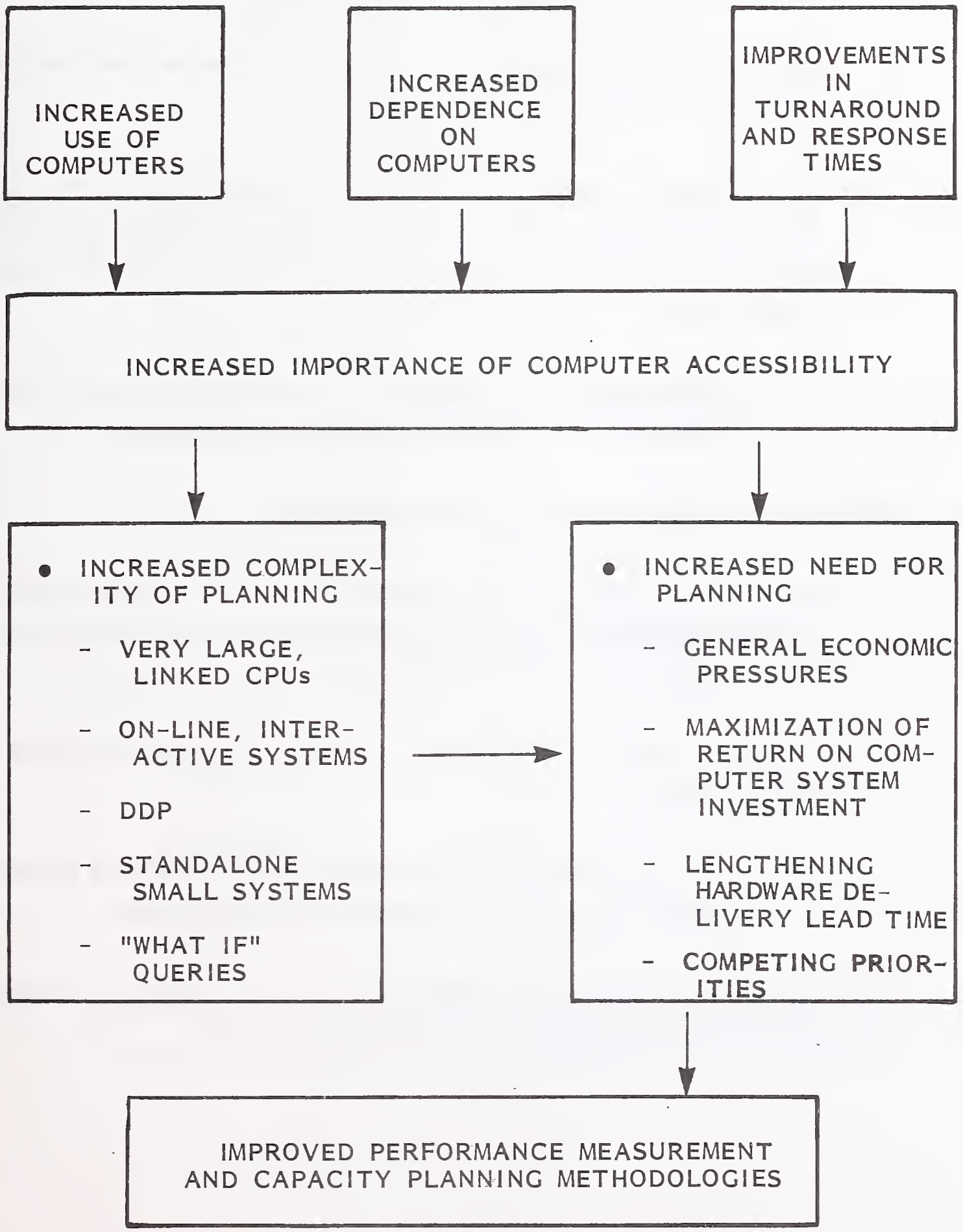


©1981 by INPUT. Reproduction Prohibited.

INPU
U-SPE

EXHIBIT II-2

FORCES DRIVING CAPACITY PLANNING



©1981 by INPUT. Reproduction Prohibited.

- The vast majority of organizations are currently struggling to establish an effective performance measurement program.

  - Too often the function is viewed as a technical process divorced from the rest of the MIS organization, as well as from users.

  - One-third of installations surveyed do not yet have regularly assigned staff for the function.

  - While a large number of performance measurement tools are being used, there is little consistent pattern to their use; many installations admitted that they are not receiving full benefits even from their present tools.

    . While benefits were cited from the use of existing tools, in many cases they were not based on reliable, comprehensive data.

- Similar problems exist in making workload projections.

  - Installations typically cited a successful record in making projections. However, the baseline data to make solid quantification often appeared to be lacking.

  - Many firms have a "batch" view of capacity planning rather than an "on-line" view.

    . They see their computer system as being at "X%" of capacity, rather than in terms of response or turnaround times.

- Many performance measurement software tools are now offered, as well as a growing, but still small, number of capacity planning tools.

©1981 by INPUT. Reproduction Prohibited.

- Unfortunately, the tools are usually used in an uncoordinated and unintegrated fashion, often complicating the problems of managing a data processing installation.

- The knowledge and use of capacity planning tools are quite limited.

  . It is doubtful that sophisticated capacity planning can be done without using specialized tools.

- To be effective, each function of performance measurement and capacity planning will have to be integrated, as shown in Exhibit II-3.

  - Software tools will have to be integrated.

  - Capacity planning must link up with MIS planning in general, as well as with overall business planning.

  - Both the operations and development sections within MIS will have to work with users.

- However, this integration cannot stop with the individual functions, but must become an integrated system, as shown in Exhibit II-4:

  - People.

  - Planning.

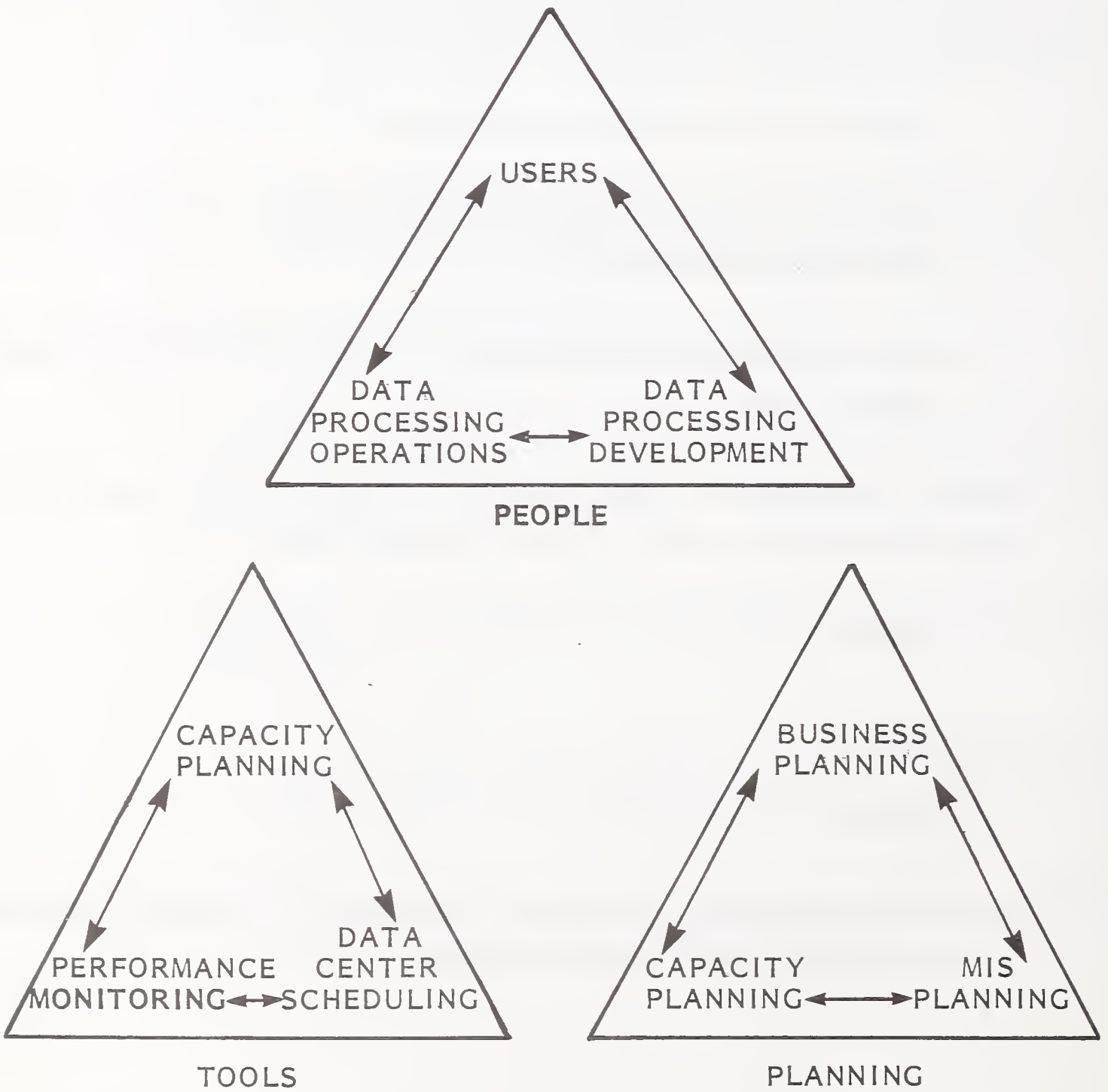
  - Tools.

- Performance measurement and capacity planning can be powerful facilitators of a system-wide approach to data processing.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT II-3

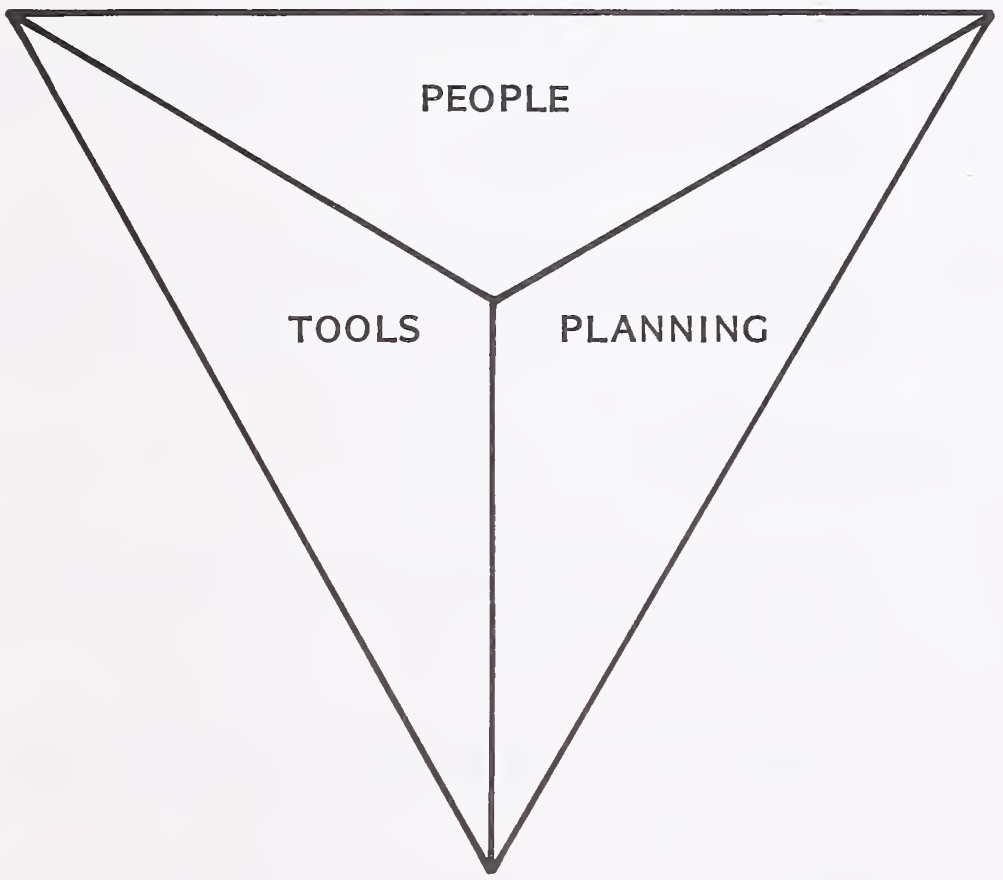
CAPACITY PLANNING FUNCTIONS



©1981 by INPUT. Reproduction Prohibited.

EXHIBIT II-4

THE COMPONENTS OF AN
INTEGRATED CAPACITY PLANNING SYSTEM



©1981 by INPUT. Reproduction Prohibited.

- Sufficient capacity is what both MIS management and user management need. Working together to ensure this can serve as a means of having them see their common, rather than antagonistic, interests.

- INPUT recommends that MIS management attack the performance management and capacity planning problem on several different levels:

  - Strategically.

    . Gauge the level of effort that will be expended. Too much effort may sometimes be as inappropriate as too little; however, current experience is generally inadequate, rather than excessive.

    . Lay the foundation for later progress by training and educating MIS staff and users.

    . MIS management should take an active role in capacity planning. (It will be held responsible for failures in any event.)

  - Organizationally.

    . Treat capacity planning as a process requiring a wide range of skills.

    . Meld people of different backgrounds by using a task force.

  - Tactically.

    . Set up plans for shedding workloads.

    . Consider keeping a "tactical reserve" of unused resources that can be called on in times of need.

    . Use good software tools (see Appendix D).

©1981 by INPUT. Reproduction Prohibited.

III THE CONCEPTUAL FRAMEWORK

III THE CONCEPTUAL FRAMEWORK

A. THE IMPORTANCE OF PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

- Are performance measurement and capacity planning important? Is performance measurement only a justification for systems programmers? Is capacity planning only an exercise that is gone through every time data processing management "knows" that it needs more hardware? Some installations probably still operate that way, but many other MIS managers are realizing that measurement and planning are vital for carrying out their missions.

- A large part of the reason for the increasing importance of performance measurement and capacity planning is that data processing has become more successful and accepted, so much so that it has become critical to the profitability of many organizations.

  - Several respondents used the phrase that nowadays it is a "bet your company" situation that data processing would perform its mission as intended.

    . One company estimates that $25,000 per minute of cash flow is threatened when its computer system is down during peak hours.

©1981 by INPUT. Reproduction Prohibited.

  - Another company, which has seen its 3380 delivery dates slip six months, is carrying $3 million per day of interest charges on a very large project that is computer-dependent in many of its phases.

- For many organizations, this critical position has been reached only recently and has occurred gradually over a period of time. Many non-DP managers in companies where data processing has become critical to the organization's success have not really grasped the full implications of the changed environment.

- Part of the reason for this delayed acceptance has been that the MIS department itself has often not adjusted to the changed environment.

  - Computer operations should be receiving attention and resources at least on a par with the development unit. However, this has not happened. Partly, it is a question of glamor.

  - However, there is also a perceptual lag. In the era of batch systems, the primacy of development could be justified on the basis that system development was very difficult and also was breaking new ground. Operational problems could usually be resolved with the application of brute force.

- On-line systems present an entirely different set of issues. Here successful development is merely the first step. Afterward, the prime question becomes system accessibility. Namely:

  - Is the system available when needed?

  - Is response time adequate?

©1981 by INPUT. Reproduction Prohibited.

- These changes are shown in Exhibit III-1, where processing time has generally shortened, while the importance of accessibility has increased.

  . Note that special queries to data bases will often have a high turnaround time priority but will not be very predictable. Such queries may also place heavy burdens on computer resources.

- Most users now "grade" the MIS function on the basis of accessibility. Since larger and larger sections of most organizations are using on-line systems, MIS departments will rise or fall on accessibility.

  . Hence, the computer operations area should receive an equitable share of MIS resources: quantitative, qualitative, and intellectual.

  . This has not yet widely occurred, as is apparent in visits to many data processing installations. Additional confirmation is shown by the generally low level of disaster recovery preparations and, as shown in this study, performance measurement and capacity planning.

- Performance measurement and capacity planning are among the chief methods of ensuring proper accessibility of computer resources.

B. COMPONENTS OF PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

- The terms "performance measurement" and "capacity planning" are shorthand for an interrelated process which starts with performance measurement and ends with capacity planning. Exhibit III-2 shows this process in pictorial form, with performance measurement as the foundation and capacity planning the capstone.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-1

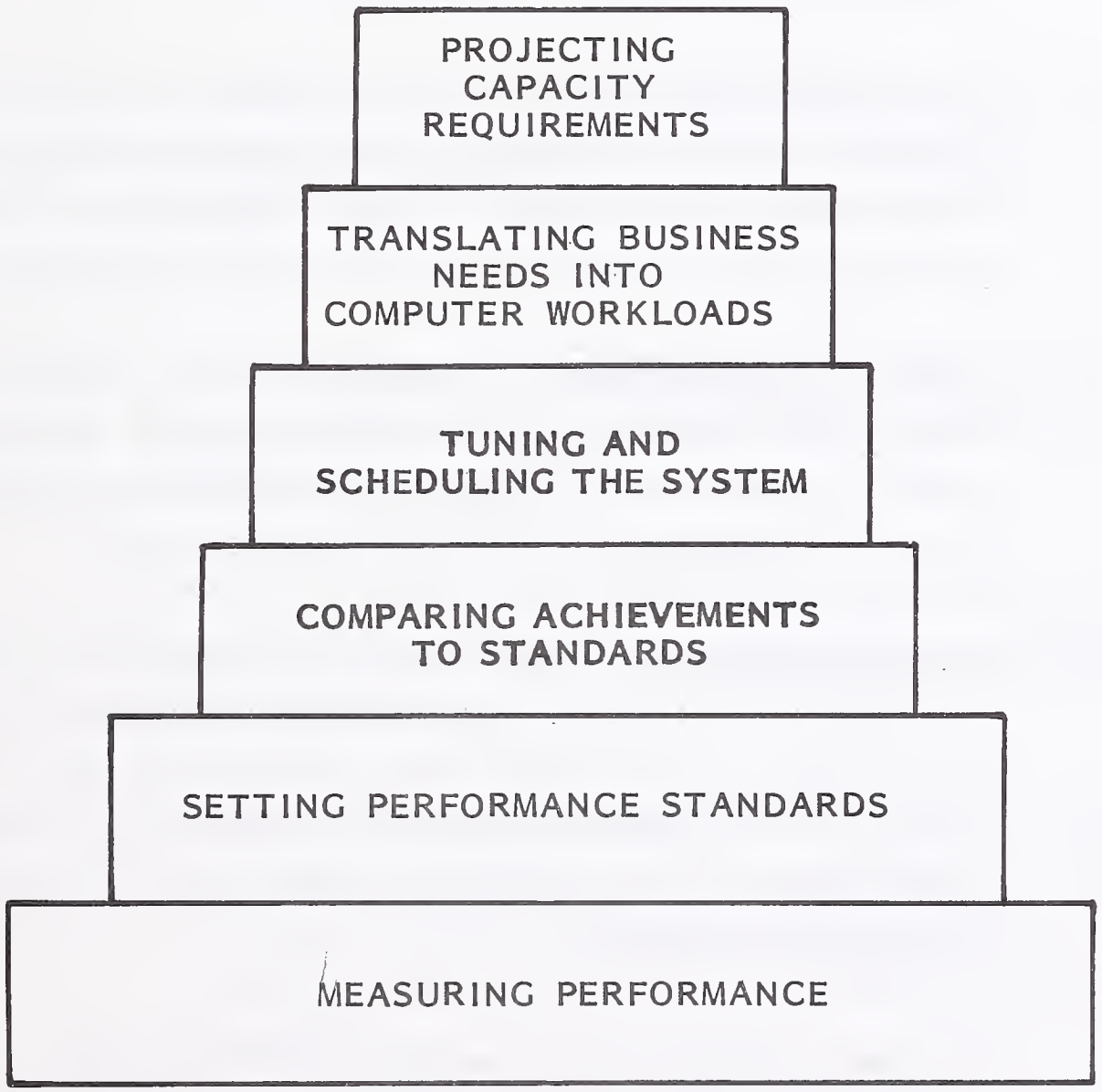
CHANGING PATTERNS IN COMPUTER PROCESSING

TYPE OF SERVICE	DEMAND PREDICT-ABILITY	TYPICAL TIME SCALE FOR PROCESSING
• BATCH PROCESSING (PAPER DOCUMENTS)		
- EDIT TURNAROUND	MEDIUM	DAYS
- DATA BASE UPDATE	HIGH	WEEKS
- REPORTS TO USERS	HIGH	WEEKS
• BATCH PROCESSING (RJE INPUT/OUTPUT)		
- EDIT TURNAROUND	HIGH	HOURS
- DATA BASE UPDATE	HIGH	DAYS
- REPORTS TO USERS	HIGH	DAYS
• DATA BASE INTERROGATION		
- REGULAR REPORTING	HIGH	HOURS
- SPECIAL "WHAT IF" QUERIES, ETC.	MEDIUM/LOW	HOURS/DAYS
• INTERACTIVE TRANSACTION PROCESSING		
- EDIT TURNAROUND	HIGH	SECONDS
- DATA BASE UPDATE	HIGH	SECONDS
- REPORTS TO USERS	HIGH	HOURS

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-2

BUILDING CAPACITY PLANNING CAPABILITY



©1981 by INPUT. Reproduction Prohibited.

- This entire process is sometimes given other names, such as performance management, to connote the integrative aspects of the process.

- Each of the levels shown in Exhibit III-2 builds on the previous ones. This section will provide a brief overview of each level. The remaining sections of this chapter will deal with each level in detail.

  - Measuring performance provides the baseline data required for setting standards or making improvements. Otherwise, "You can't get there from here." There are numerous software- and hardware-based measuring tools to assist in this process.

  - Once a baseline describing current performance has been defined, it is possible to negotiate the setting of performance standards with users. This process is in its infancy in most organizations. However, it is required in order to know how well the system is performing.

  - Comparing achievements to standards becomes relatively straightforward once the earlier steps have been completed. At this point, it is possible to begin making capacity need projections by establishing the extent to which performance standards have been met.

  - Tuning and scheduling make sense only if they can be compared to unambiguous baseline performance data and to a performance standard. All too often, current tuning and scheduling take place in a vacuum with no real knowledge of how current achievements compare to the historic record or, more importantly, how well (or how poorly) user needs are being satisfied.

  - The most difficult step in preparing a capacity plan is translating business needs into computer workloads. There are several aspects to this:

©1981 by INPUT. Reproduction Prohibited.

- . Trends, especially seasonal variations, as shown in historic data.

- . Business plans which would modify the historic data (either in the rate of growth or seasonality). For example, an application may receive significant enhancements or additional users and require substantially more computer resources.

- . New applications being developed. Some are similar to existing applications and may consequently be planned by analogy. Others, however, may be totally new and previous experience would not be useful.

- . Finally, there may be underlying changes in the business that would have profound effects on computer requirements (acquisitions, new lines of business, geographic expansion or contraction, etc.).

- . As can be seen, at a certain point effective capacity planning must become a subset of overall business planning and information system planning.

- Finally, if all the data and analyses of prior steps have been carved out adequately, it will be possible to project capacity requirements of the hardware configuration.

  - . There are several recently offered software aids which promise to make the mechanics of this step faster and more straightforward. However, the value of capacity planning software is largely dependent on a solid factual base informed by intelligent analysis.

  - . Hardware issues will soon become more complex as distributed processing networks and standalone minicomputers become more significant factors.

©1981 by INPUT. Reproduction Prohibited.

- The succeeding sections of this chapter will discuss each component in more detail and provide much of the conceptual framework for later discussion of the current status in the field, future trends, and INPUT's recommendations to data processing installations.

  - This conceptual framework is not theoretical but is based upon situations observed while conducting this study, as well as the observations and analyses of those who have spent many years working in or reporting on this field.

C. PERFORMANCE MEASUREMENT

- There are a large number of aids and tools to assist in collecting and presenting data on system performance. Tools fall into the following general categories (although there is sometimes overlap between categories for specific tools):

  - Job accounting packages.

  - Performance monitors.

    . General-purpose software monitors.

    . Specialized software monitors.

    . Hardware monitors.

  - Capacity planning software (to be discussed more fully in Section H of this chapter).

- Exhibit III-3 provides an overview of the different types of tools, their function, and the major uses to which they are put.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-3

TOOL TYPES AND USES

TOOL TYPE	FUNCTION	EXAMPLES OF MAJOR USES
JOB ACCOUNTING PACKAGE	• DESCRIBES USE OF SYSTEM, BY TYPE OF USE AND USER • DATA SOURCE: SMF DATA TYPICALLY	• CHARGEBACK • BUDGETING • FIRST-LEVEL PERFORMANCE MONITORING
PERFORMANCE MONITOR (IN GENERAL)	• REPORTS ON SYSTEM PERFORMANCE	• PERMITS MORE COMPREHENSIVE PERFORMANCE MONITORING • PROVIDES BASELINE DATA FOR SYSTEM TUNING • PROVIDES HISTORIC DATA FOR FIRST-LEVEL CAPACITY PLANNING
GENERAL-PURPOSE SOFTWARE MONITOR	• DESCRIBES PERFORMANCE OF OVERALL SYSTEM • DATA SOURCE: RMF DATA TYPICALLY	• SYSTEM TUNING
SPECIALIZED SOFTWARE MONITOR	• DESCRIBES PERFORMANCE OF A SYSTEM COMPONENT • DATA SOURCE VARIES	• MONITORING AND TUNING OF PARTICULAR SUBSYSTEMS; E.G., DASD SPACE, IMS, TSO, ETC.
HARDWARE MONITOR	• DESCRIBES PERFORMANCE OF COMPLEX SYSTEMS • DATA SOURCE: SPECIAL PHYSICAL PROBES	• MONITORING AND TUNING LOOSELY COUPLED CPUs • COMMUNICATIONS NETWORK MONITORING AND OPTIMIZATION
CAPACITY PLANNING SOFTWARE	• DESCRIBES EFFECTS OF WORKLOAD CHANGE ON HARDWARE REQUIREMENTS • DATA SOURCES: (A) SMF/RMF/MONITORS (B) ESTIMATES OF FUTURE LOADS	• PROJECT EFFECTS OF A NEW APPLICATION SYSTEM • PROJECT EFFECTS OF ADDITIONAL USE OF A CURRENT SYSTEM

©1981 by INPUT. Reproduction Prohibited.

- One of the questions which arises in performance measurement is the differences between, and advantages of, hardware versus software monitors. Exhibit III-4 summarizes the major differences.

  - In general, software monitors are easier to use and do not require highly skilled personnel.

  - Software monitor acquisition cost is much less expensive (sometimes by an order of magnitude). Formerly, software monitors imposed a significant overhead cost on the system (upwards of 10%). However, newer software monitors may impose little more than 1%. (The actual overhead will vary, depending on how often they are used and how much detail is collected.)

  - Hardware monitors are by their nature more precise than software monitors, since they are collecting electrical impulses rather than sampling sometimes ambiguous system or program events.

    . However, making sense of the data collected by hardware monitors sometimes requires a high degree of experience, i.e., it is as much of an art as a science.

  - However, there are certain situations which only a hardware monitor can measure, most notably, loosely coupled CPUs with shared direct access storage devices (DASD).

    . This is due to the hardware monitor's ability to have its probes connected to a number of semi-independent points in the configuration and to integrate the data received.

    . Software monitors residing in different CPUs, on the other hand, cannot feasibly have their outputs meshed; a software monitor resident in one CPU cannot measure what is occurring in another CPU.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-4

DISTINCTIONS BETWEEN HARDWARE AND SOFTWARE MONITORS

CHARACTERISTICS	MONITOR TYPE	
	HARDWARE	SOFTWARE
• MEASUREMENT TYPE	CONTINUOUS*	SAMPLING
• PROCESSOR INDEPENDENCE		
- SIMULTANEOUSLY MEASURES MULTIPLE CPUs WITH SHARED DASD?	YES	NO
- MEASUREMENTS AFFECTED BY PROCESSOR FAILURE?	NO	YES
- MONITOR IMPOSES OVERHEAD ON PROCESSOR?	NO	YES (2-5%)
- MONITOR CAPTURES APPLICATION-SPECIFIC DATA (E.G., PROGRAM ID)?	NO	YES
- MONITOR PORTABLE BETWEEN DIFFERENT OPERATING SYSTEMS AND VENDORS' HARDWARE?	YES	NO (USUALLY)
• EASE OF USE		
- REQUIRES KNOWLEDGE OF PROCESSOR ARCHITECTURE?	YES	NO (USUALLY)
- REQUIRES SUBSTANTIAL INITIAL TRAINING?	YES	NO
- REQUIRES HIGHLY SKILLED PERSONNEL?	YES	NO
- MONITOR HIGHLY FLEXIBLE?	YES (IN PRINCIPLE)	NO
• PRICE	HIGH ($60,000-400,000)	LOW/MODERATE ($5,000-25,000)

*UNDERLINING DENOTES THE MORE VALUABLE CHARACTERISTIC

©1981 by INPUT. Reproduction Prohibited.

- However, hardware monitors are not the complete answer. They only measure externally gathered electrical impulses and, not being resident in the CPU, cannot associate these measurements with particular application systems.

- The ideal (although it might be very expensive) would be an integrated hardware/software monitor; this does not now exist.

- Even if such an improved monitor did exist it would be useful only in installations that had succeeded in wringing most of the useful information out of present monitors.

- A similar distinction should be made between job accounting packages and software monitors.

- Job accounting packages perform well for what they are intended to do: describe the activity associated with individual jobs or subsets and supersets of jobs.

  - However, for the most part, job accounting packages are based on SMF-type data (or whatever the non-IBM hardware manufacturer may call it) which looks at individual job or job stop performance.

  - Software monitors, on the other hand, access RMF data, which looks at the system as a whole. Thus, the typical general-purpose software monitor can give a much deeper and broader view of the system than a job accounting package alone can. Exhibit III-5 shows these contrasts for typical capabilities.

  - Note, for example, that for the key metric of response time a software monitor is needed.

- The general principles described here exist for both the IBM and non-IBM world.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-5

CONTRASTS IN CAPABILITIES OF JOB ACCOUNTING PACKAGES AND SOFTWARE MONITORS

REPORTING CAPABILITY	REPORTED BY	
	JOB ACCOUNTING PACKAGE	SOFTWARE MONITORS
TURNAROUND ELAPSED TIME	X	X
RESPONSE TIME	-	X
CPU UTILIZATON	X	X
OVERLAPS, WAITS	-	X
EXCP ACTIVITY	X	X
CHANNEL UTILIZATION	-	X
PAGING ACTIVITY	X	X
WORKING SET SIZE	-	X
DISK EXCPs	X	-
DISK QUEUES, FREE SPACE	-	X

©1981 by INPUT. Reproduction Prohibited.

- All hardware manufacturers offer a built-in collection system analogous to IBM SMF/RMF capabilities. However, beyond manufacturer-supplied collection and reporting facilities there is not a great deal available to non-IBM installations:

  . In the course of preparing this report, INPUT analyzed a large subset of software products currently available for performance measurement and improvement. Not surprisingly, over three-quarters of these were aimed at IBM users, as shown in Exhibit III-6.

- Other manufacturers are concerned about this problem and realize that they must provide adequate support for their customers' performance measurement and capacity planning:

  . Burroughs, for example, introduced in April 1980 a significant enhancement to its SPARK package.

  . Besides improving existing reporting on workload characterization and utilization measurement, SPARK will report on detected hardware faults and overall system availability.

  . Tandem has built much of the performance data collection facility into its computer systems. This monitor (XRAY) is unwieldy and needs a sophisticated systems programmer-type user. However, some Tandem users don't have <u>any</u> programmers.

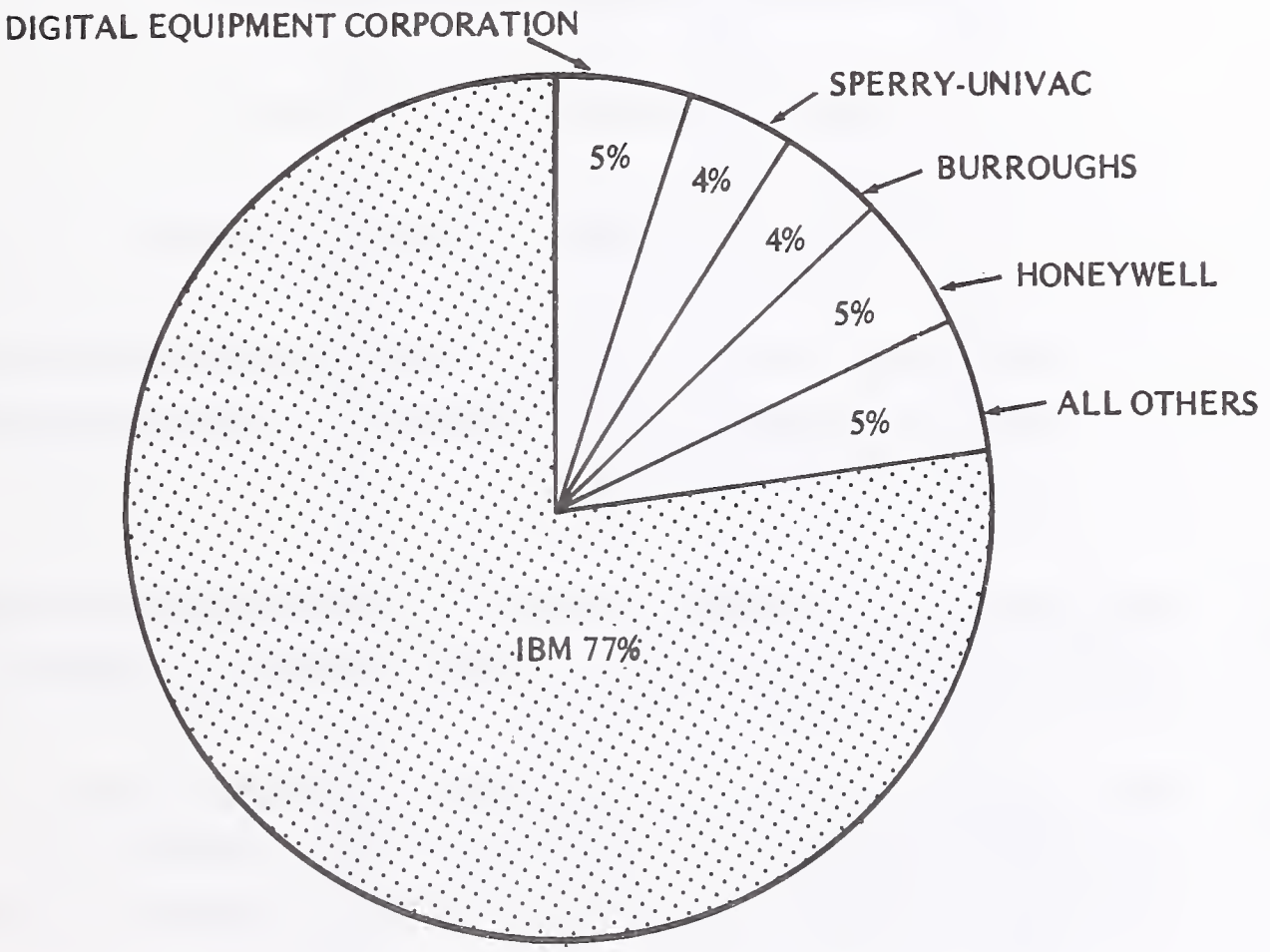
  . Obviously, minicomputer companies like Tandem are going to have to take a different approach from the mainframe manufacturers.

- However, except for the range of products offered to IBM users, the issues and solutions do not differ markedly between mainframe manufacturers. The resources and sophistication available to an installa-

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-6

APPLICABILITY OF PERFORMANCE MEASUREMENT AND IMPROVEMENT SOFTWARE PRODUCTS TO PARTICULAR HARDWARE ENVIRONMENTS



TOTAL PRODUCTS AVAILABLE = 159

SOURCE: INPUT TABULATION

©1981 by INPUT. Reproduction Prohibited.

tion, and the intelligence applied to problems, are typically more important factors than the type of hardware employed.

D. PERFORMANCE STANDARDS

- Performance standards must be established to reflect business reality; this means serious negotiations with the users involved.

  - For most users, accessibility is the key issue:

    . Response time for interactive system.

    . Turnaround time for batch and RJE systems.

  - However, there is a real price associated with most improvements and thorough analysis must be undertaken to see if the economic benefits balance the increased costs.

- A semiautomatic method to effect the negotiations and external analysis required in setting performance standards would be very appealing.

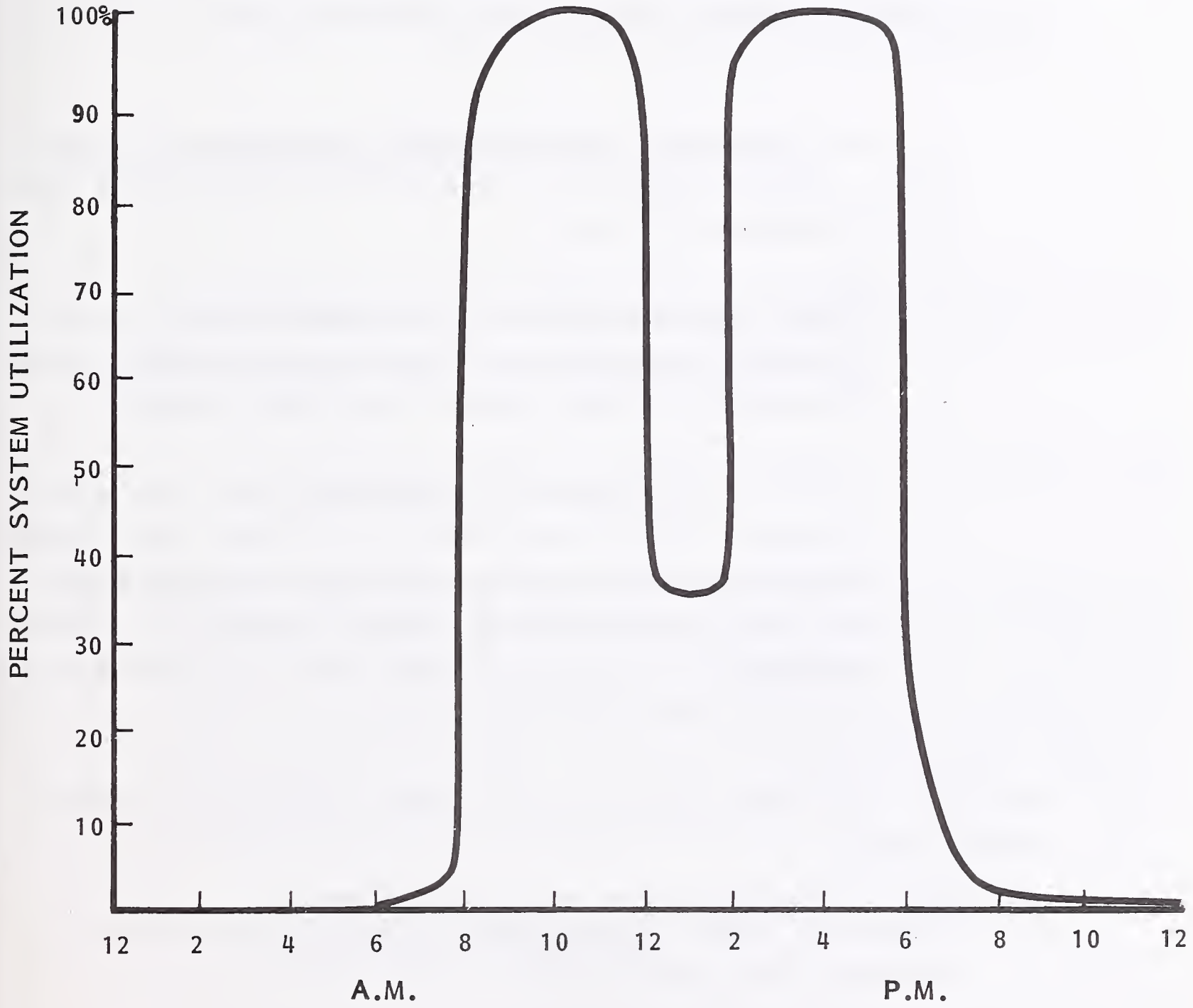
- One approach, which has considerable intellectual appeal, is to allocate computer resources by a pricing mechanism, allowing users to decide for themselves whether a certain level of service is economically justified.

  - However, there are practical problems, illustrated in the situation shown in Exhibit III-7. This shows an on-line system with its classic twin usage peaks. Theoretically, a time-of-day chargeback system (based on data collected by the job accounting system) would spread usage throughout more of the day. However in some cases a charge-back system's success has led to its ultimate failure:

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-7

PROPORTION OF A
COMPUTER SYSTEM CONSUMED
BY AN ON-LINE APPLICATION



©1981 by INPUT. Reproduction Prohibited.

        - If the underlying application is an order entry system, for example, it would be counterproductive to discourage order clerks from using the system immediately to look up stock status, quote additional prices, enter cancellations, etc.

- System costs might be lower if these "marginal" functions were postponed to an off-peak time; however, the usefulness of the system - and its impact on the bottom line - would be negatively affected.

    - In many other cases a chargeback system would have only minimal effect. Take, for example, an interactive user system or a TSO program development system:

        - Within very broad limits, users are insensitive to the cost of computer time compared to personnel expense, deadlines, etc. (the charges are usually a form of "funny money" anyway).

        - If it is really important to off-load such work, then pricing becomes a rather minor weapon in an armory which would include such things as flextime, terminals at home, exhortation (or threats), and good off-hour response time (since all too often response at 7 p.m. may be no better than at 2 p.m. because of large batch jobs or maintenance).

- The job of negotiating with users becomes one of rationing a scarce, but "free," resource.

    - Would it be better to avoid battles and <u>not</u> establish quantified and auditable performance standards?

        - Yes, perhaps in the short run, especially if the organization as a whole does not or cannot plan effectively.

©1981 by INPUT. Reproduction Prohibited.

. However, in the longer run there is no avoiding the issue, since the user will always have implicit service standards that MIS will be judged by. In some cases a frank discussion of the issues involved will result in explicit standards that are easier to meet.

- In a "rationing" atmosphere it becomes critical to involve top management. One of management's roles is to allocate resources or, in this case, to approve an approach for allocating resources.

E. COMPARING ACHIEVEMENTS TO STANDARDS

- Contrasting actual performance against previously agreed upon standards is a job that will never end. The data processing department does not want to either exceed or fall short of the standard significantly.

  - To routinely exceed the standard may give rise to a new de facto standard, which may not be needed.

- Regular reports of actual versus planned performance should be provided to all user departments. Great care should be taken to ensure that the reports are meaningful and that both sides agree on the definition of a particular standard. Definition and selectivity are very important in performance reporting, but it can sometimes be difficult to arrive at meaningful reports. Take, for example, the key metric of system availability:

  - It sometimes seems that users and MIS inhabit different worlds (or at least use different computers).

    . Users may complain about their system "always" being down.

    . MIS management reports that the system is up, say, 98% or 99% of the time.

©1981 by INPUT. Reproduction Prohibited.

. They may both be right, according to their separate definitions.

- The user's figure is, of course, very impressionistic. However, upon analysis, suppose a typical terminal is shown to be unavailable for use during 20% of the prime shift.

- Data processing operations, on the other hand, measure the time the CPU is available (less eight hours scheduled maintenance); its logs show a figure of 98.7%.

- However, the CPU is of little use to a user unless the entire hardware/software configuration is available. Exhibit III-8 lists the typical components of a system which an on-line application would use and shows illustrative reliability factors.

. Each component is assumed to have a high degree of reliability.

. However, the system's reliability is only 87%.

- If the reasonable assumption is made that a disproportionate number of failures occur during the prime shift, then the reported 1% and 20% failure rates are in fact describing the same universe.

- This kind of measurement is often not performed because it is much harder to measure total system availability and even harder to measure availability of individual components. In addition, the psychic rewards to MIS management are much less. MIS management would have to adjust to performing at an order of magnitude worse than they had previously expected.

. However, without such realism, it will be impossible for MIS management to have meaningful dialogues with users and to take constructive action on real problems.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-8

COMPUTER SYSTEM VERSUS COMPONENT RELIABILITY

(HYPOTHETICAL EXAMPLE)

COMPONENT	UP-TIME (PERCENT)*
HARDWARE	
INDIVIDUAL TERMINAL	99%
MODEMS	99
LINES	99
MULTIPLEXOR	99
CONTROLLER	99
DASD	99
CHANNEL	99
CPU	99
TOTAL HARDWARE	92%
SOFTWARE	
DBMS	98%
TP CONTROL PROGRAM	99
OPERATING SYSTEM	99
APPLICATION SOFTWARE	99
TOTAL SOFTWARE	95%
TOTAL PROCESSING SYSTEM	87%

* FIGURES FOR ILLUSTRATION ONLY.

©1981 by INPUT. Reproduction Prohibited.

- Because of the danger of regular reporting going unintentionally askew, other means of feedback from users should be formalized and encouraged.

  - A quarterly "report card" from users, for example, will often bring out unsuspected problems, as well as open another means of communication.

F. TUNING AND SCHEDULING

- Most installations are already doing a considerable amount of tuning and scheduling.

  - However, even most advanced installations are just beginning to set meaningful performance standards. This raises the question of whether there are specific objectives for present tuning and scheduling.

- Much existing tuning either occurs inside a closed system or entails "firefighting."

  - "Closed system" tuning is where a systems programmer analyzes performance measurement reports and sees an opportunity, for example, to reorganize DASD data sets and reduce average response time by, say, one second for a particular application.

    . This is good as an end in itself since everyone in data processing (especially systems programmers) likes efficiency. But did <u>that</u> application need the improvement? Perhaps that particular application could have had other priorities lowered (so it received no net benefit), with the freed resources used to help another application.

©1981 by INPUT. Reproduction Prohibited.

- "Firefighting" is self-explanatory. The question is: Need it have occurred? Would better performance measurement and analysis have identified the problem before the critical stage? Or were there no performance standards against which to make the judgment that the critical stage was approaching?

G. TRANSLATING BUSINESS NEEDS INTO COMPUTER WORKLOADS

- Translating business needs into overall computer solutions should be one of the main concerns of the MIS department. If this is so, then one important part of the "computer solution" is estimating hardware requirements. However, this state has not been reached in a great many computer installations.

- User departments and/or the corporate planning function should be the best source for information on projections for such things as:

  - Increased business by area and/or product line.

  - New business plans.

  - Changes in product or service composition that would affect data processing needs.

  - Seasonal business patterns; current as well as potential changes.

  - Present and projected geographic patterns of business.

- The MIS department will then have to take these needs (sometimes called "natural business units," "forecast units," etc.) and translate them into computer resource equivalents.

©1981 by INPUT. Reproduction Prohibited.

- Software tools, described in the following section of this chapter, can be of great assistance.

- However, the basic problem is one of understanding, and should not be underestimated. A very rare and high-quality person is needed for this kind of work.

- At this point, some readers will be thinking, "We have high-powered systems analysts and architects who really understand the business and are already performing just this kind of translation."

  - The problem may be that they are performing a different sort of translation. They are looking at logical processes, data base designs, and, hopefully, user-friendly systems.

    . They often do not care about operations requirements ("Buy another machine").

  - Exhibit III-9 is an attempt to quantify the priorities for most system development personnel.

    . They may, in fact, be quite correct in relegating computer resource questions to the backs of their minds. A million dollars or more of additional hardware may be a perfectly acceptable trade-off for a user-accessible data base, maintainable programs, etc.

  - However, data processing operations may not have an inkling of the magnitude of resources required until it is far too late to do such things as:

    . Order required hardware.

    . Optimize code.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-9

HYPOTHETICAL PRIORITIES OF A SYSTEM DEVELOPMENT GROUP

CRITERIA	IMPORTANCE
FINISH ON SCHEDULE	10
FINISH WITHIN BUDGET	9
MEET USERS' FUNCTIONAL REQUIREMENTS	8
MAXIMIZE STAFF PRODUCTIVITY (E.G., LINES OF CODE PER DAY)	8
PRODUCE MAINTAINABLE SYSTEMS	6
DEVELOP AN INTEGRATED DATA BASE	6
MEET RESPONSE TIME REQUIREMENTS	6
MINIMIZE COMPUTER RESOURCES NEEDED	2

(10 = HIGH PRIORITY, 1 = LOW PRIORITY)

©1981 by INPUT. Reproduction Prohibited.

. Off-load other systems, etc.

- The bottom line is that the development group usually cannot be expected to look after operations' interests.

H. PROJECTING CAPACITY REQUIREMENTS

- Some installations apparently still project their requirements by assuming that the future consists of a straight line (or at the worst, a slightly curved line). Any installation which uses only regression analysis for capacity planning is in this category. Exhibit III-10 shows how people with this point of view would implicitly view workload projection and capacity planning. (They probably would also use CPU capacity resource units as their measure of capacity.)

- Real life is far more complicated. Exhibit III-11 shows the kinds of curves that reflect actual conditions, and Exhibit III-12 shows a few, quite simplified, possible growth scenarios.

  - Exhibit III-13 quantifies the scenarios' assumptions.

- Two sets of scenarios are charted in Exhibit III-14.

  - All scenarios (Group "I") growing a total of 21% over 18 months.

  - The higher growth scenarios (B, C, D, H, or Group "II") growing 76% over 18 months.

  - Both groups show episodic growth in transactions processed.

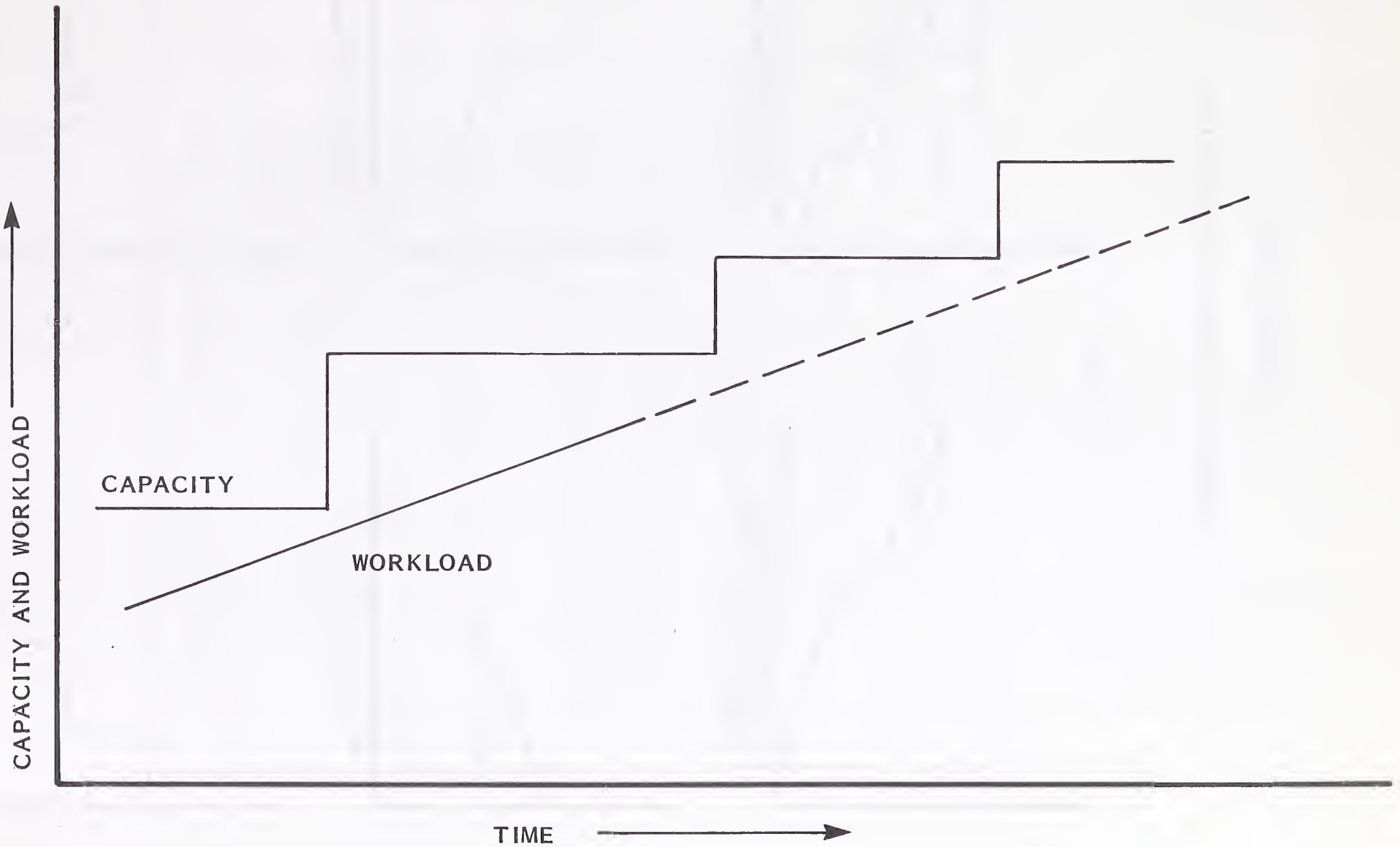
    . Group I ranges from 6% to 12% per six-month period.

    . Group II ranges from 9% to 19% per six-month period.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-10

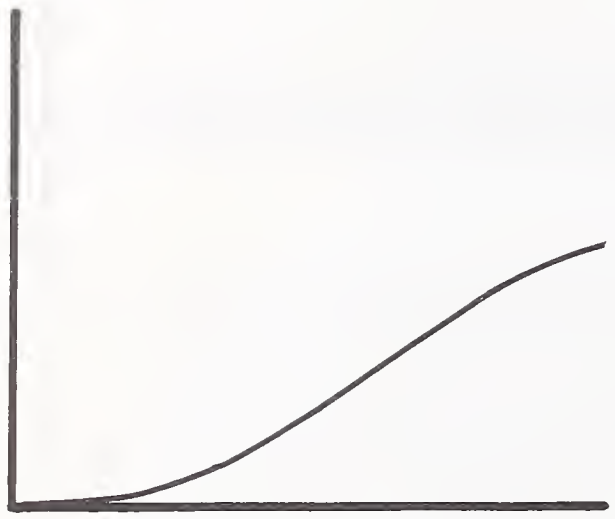
HYPOTHETICAL RELATIONSHIP OF GROWTH IN WORKLOAD TO INCREASES IN HARDWARE CAPACITY



©1981 by INPUT. Reproduction Prohibited.

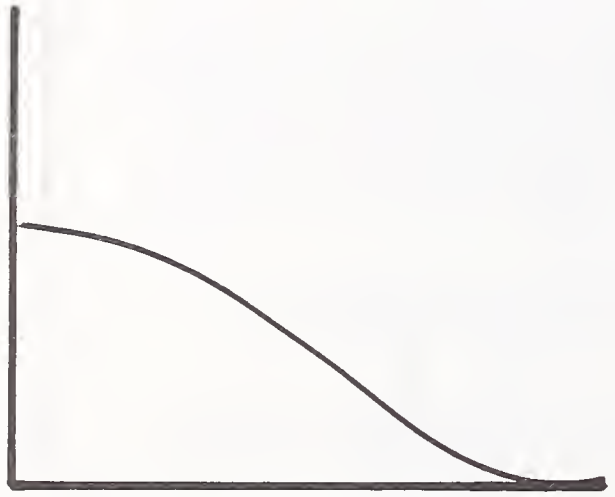
EXHIBIT III-11

CAPACITY CURVES (SCHEMATICS)

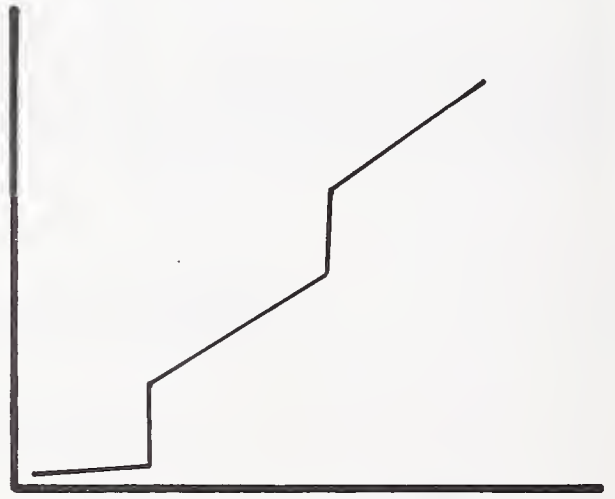


NEW APPLICATION (OR OLD APPLICATION WITH GROWING NUMBER OF USERS)

NEW FUNCTIONS INTRODUCED TO OLD SYSTEM

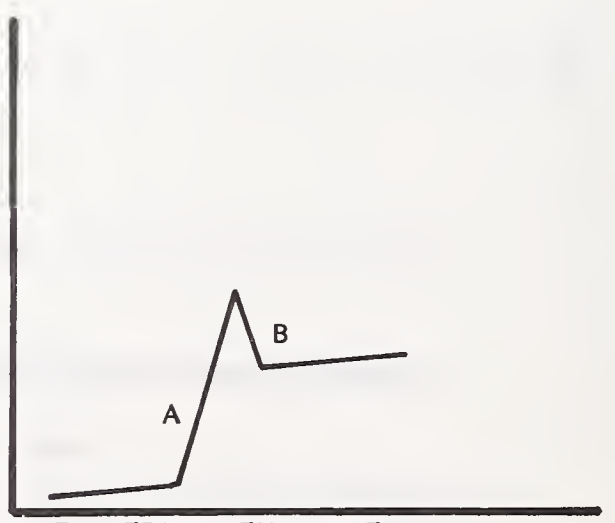


APPLICATION PHASING OUT



AS ABOVE, WITH THE NUMBER OF TERMINALS ALSO INCREASED

FUNCTIONS/USERS OFF-LOADED ONTO STANDALONE MINIS



NEW DEPARTMENT ADDED
(A) INITIAL LEARNING CURVE, HIGH ENTHUSIASM
(B) MORE EFFICIENT USE, "JOYRIDERS" DROP OFF

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-12

GROWTH SCENARIOS

SCENARIO	DESCRIPTION OF COMPUTER RESOURCE USAGE PER SIX-MONTH INTERVAL
A	STEADY 3% GROWTH IN TRANSACTIONS
B	STEADY 10% GROWTH IN TRANSACTIONS
C	10% GROWTH, WITH ENHANCEMENTS AT SIX-MONTH INTERVALS
D	NO TRANSACTION GROWTH, BUT SIGNIFICANT ENHANCEMENTS AT SIX-MONTH INTERVALS
E	SIGNIFICANT OFF-LOADING OF TRANSACTIONS TO STANDALONE MINICOMPUTER AT SIX-MONTH INTERVALS
F	AS ABOVE, BUT A 10% DECLINE IN TRANSACTION VOLUME AFTER EACH OFF-LOADING
G	SIGNIFICANT GROWTH IN TRANSACTIONS DUE TO NEW DEPARTMENT USING TIMESHARING SYSTEM; SYSTEM ENHANCED AFTER SIX MONTHS, BUT DEPARTMENT THEN DECIDES TO USE AN IN-HOUSE MINI INSTEAD; MODEST GROWTH THEREAFTER.
H	NEW APPLICATION; 400% GROWTH (FROM A SMALL BASE) LEVELING OFF TO 50% AND THEN 25%.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-13

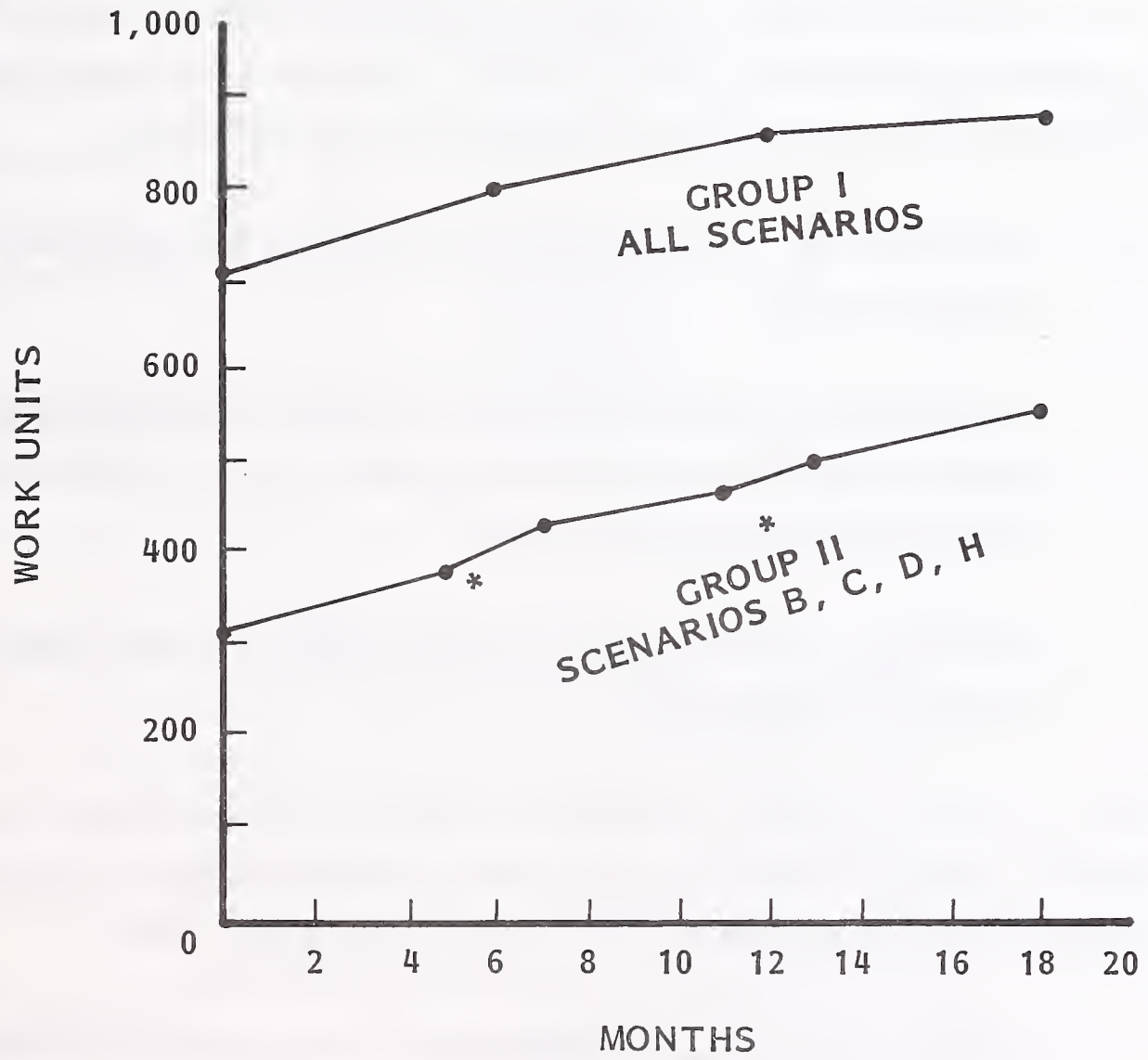
QUANTIFICATION OF GROWTH SCENARIOS

SYSTEM	FIRST SIX MONTHS			SECOND SIX MONTHS			THIRD SIX MONTHS		
	STARTING UNITS	RATE OF CHANGE (PERCENT)	ENDING UNITS	STARTING UNITS	RATE OF CHANGE (PERCENT)	ENDING UNITS	STARTING UNITS	RATE OF CHANGE (PERCENT)	ENDING UNITS
A	100	+ 3%	103	103	+ 3%	106	106	+ 3%	109
B	100	+10	110	110	+10	121	121	+10	133
C	100	+10	110	130	+10	143	163	+10	179
D	100	0	100	120	0	120	140	0	140
E	100	0	100	70	0	70	50	0	50
F	100	0	100	70	-10	63	43	-10	39
G	100	+25	125	145	0	145	105	+10	116
H	10	+400	50	50	+50	75	75	+25	94
TOTAL A-H	710	+12%	798	798	+ 6%	843	843	+ 7%	860
TOTAL B,C,D,H	310	+19%	370	410	+12%	459	499	+ 9%	546

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-14

GROWTH SCENARIOS



*ASSUMES 2-MONTH PHASE-IN/OUT

©1981 by INPUT. Reproduction Prohibited.

- In addition, there are sudden increases and decreases as systems are added or dropped.

- In neither case would regression equations be of much assistance.

- If seasonal fluctuations were introduced (conforming to the underlying trends shown) which had different cycles and amounts of fluctuation for different applications, then the analysis would become very difficult, perhaps impossible, to perform manually.

- Until recently, the number and kinds of software packages available to assist in capacity planning were fairly limited. The best known was IBM's SNAP SHOT, a simulation package used by IBM for marketing support.

  - This meant that customers could use it only at IBM facilities and could not buy or rent it.

  - Even more of a limitation for many customers is the detailed amount of data that must be collected, the special trip to an IBM site often required, and the lengthy run times.

  - IBM responds, quite correctly, that the result is a very precise picture of machine requirements.

- There are now software alternatives that bear serious looking into. The modeling package, Best/1 (by BGS Systems, Waltham, MA), for example, has found considerable acceptance since first being offered in 1978.

  - It follows a modeling, rather than simulation, approach. RMF/SMF data are combined with models of hardware configurations to develop a baseline case, as shown in Exhibit III-15. This means, at least theoretically, that there is a trade-off between precision and ease of use.

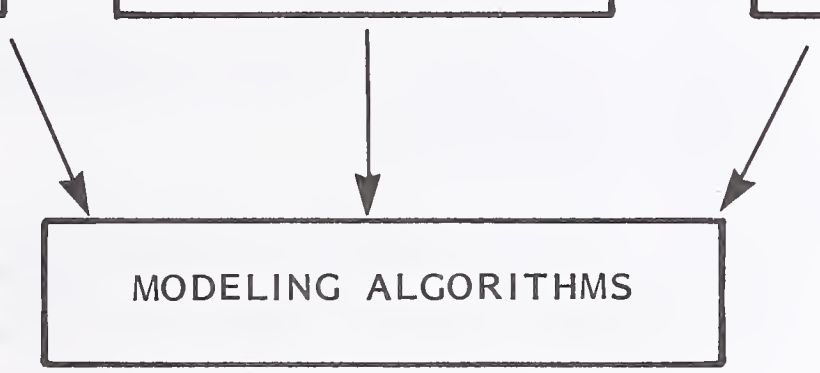
©1981 by INPUT. Reproduction Prohibited.

EXHIBIT III-15

THE MODELING APPROACH TO CAPACITY PLANNING (AS EXEMPLIFIED IN THE BEST/I PACKAGE)

INPUTS:

- **WORKLOAD HISTORY**
  - RMF DATA
  - SMF DATA
  - OTHER LOG DATA (E.G., IMS)
  - OTHER MONITOR INPUT
- **WORKLOAD VARIABLES**
  - JOB ARRIVAL RATE
  - AVERAGE/MAXIMUM LEVELS OF MULTIPROGRAMMING
- **HARDWARE PERFORMANCE CHARACTERISTICS**
  - EXISTING CONFIGURATION
  - OPTIONS



OUTPUTS:

(EXAMPLES)

- RESPONSE AND THROUGHPUT TIMES
- WAITING TIME AND QUEUE LENGTHS
- MEMORY UTILIZATION

©1981 by INPUT. Reproduction Prohibited.

  - To some extent, this is like the distinction between precision and accuracy in scientific experiments: What good does it do to take measurements to a precision of .0001 if the accuracy of the instruments is .01?

  - The analogy in capacity planning is whether simulation that may give results to, say, ±2%, is preferable if underlying key business or workload estimates vary by ±20%.

  - The importance of these theoretical issues will vary from installation to installation depending on the accuracy of the characterization of workload.

- The attractions to its users of a product like Best/1 are practical and operational:

  - It can be purchased and used completely under the control of the data processing installation.

  - In some cases only a few days are required to begin to develop (perhaps crude) answers.

  - Since significant amounts of machine resources are not needed, very valuable interactive "what if" exercises are possible.

  - Non-IBM hardware can be modeled.

  - Much of the data collection to develop the baseline model can be automated in MVS installations.

- Best/1 has been used in this discussion because it is the most established package available for acquisition (and judging from its sales growth and customer list, it has found good acceptance).

©1981 by INPUT. Reproduction Prohibited.

- Another product, Questor, with somewhat similar characteristics has more recently been marketed by Boole and Babbage. (The software was developed by Performance Systems, Inc., Rockville, MD, which also developed the simulation package SCERT.)

- It should be reemphasized that as attractive and valuable as such software tools can potentially be, they are processing only numeric assumptions and estimates.

  - To be adequate predictors, these estimates must be founded on business realities and a correct description of current operations; e.g., the complexities and ambiguities illustrated in Exhibits III-10 through III-13 must be reflected in both the baseline case and estimates for the future.

  - One of the chief virtues of simulation and modeling is to allow planners to identify variables that have the greatest effect on capacity needs; e.g., for some application/hardware settings a 20% increase in application complexity may have more impact than a 20% increase in volume (while other situations may be vice versa).

  - Identifying sensitivities should be one of the chief goals in planning of all kinds.

©1981 by INPUT. Reproduction Prohibited.

IV THE CURRENT STATUS OF PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

IV THE CURRENT STATUS OF PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

- This chapter will describe what is now happening in the field of performance measurement and capacity planning. Comparisons will be made between the current actuality and the conceptual framework established in the previous chapter. Many of the findings and conclusions are based on the interviews which INPUT conducted with MIS management.

- A key factor is the growing importance of performance measurement and capacity planning seen by respondents, compared to three years ago, as shown in Exhibit IV-1.

  - The increased importance extends across all sizes of installation, although larger installations appear to attach somewhat more importance to these functions.

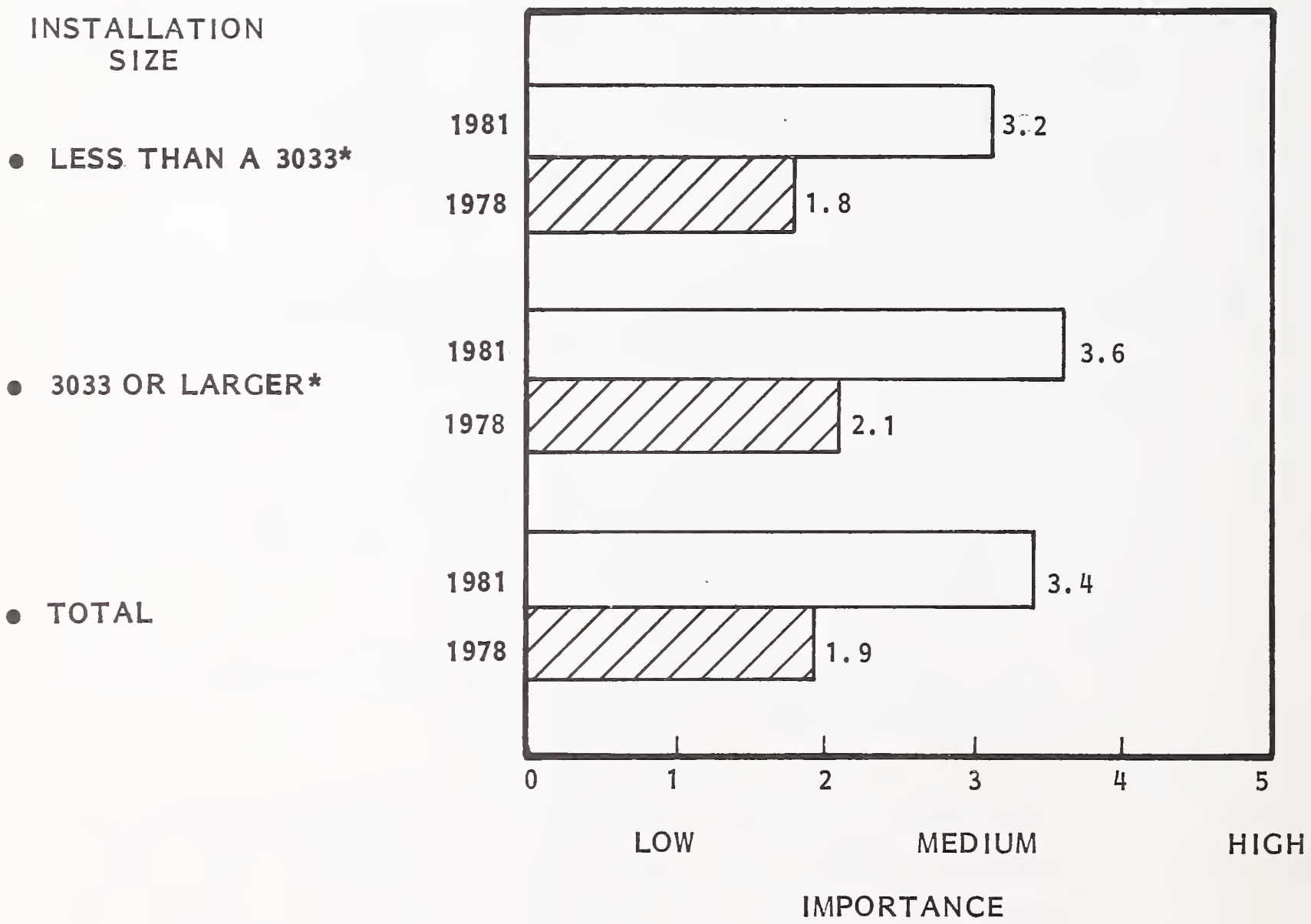
  - Even with this sizable increase in importance, the functions are still perceived to be only of medium importance.

  - This rating is especially notable since the respondents usually had a direct connection with performance measurement and capacity planning, and always had a high level of interest. However, their ratings appeared to be a very realistic reflection of the level of acceptance elsewhere in the organization.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-1

IMPORTANCE OF PERFORMANCE MEASUREMENT AND CAPACITY PLANNING AS SEEN BY MIS MANAGERS: 1981 AND 1978



NUMBER OF RESPONDENTS = 34

* OR EQUIVALENT, SIZED BY CPU RATINGS IN THOUSANDS OF OPERATIONS PER SECOND (KOPS)

©1981 by INPUT. Reproduction Prohibited.

- There do not appear to be clear patterns in the type of company that places the most (or least) emphasis on performance management and capacity planning.

  - Several companies which themselves offer data processing-based services had until recently placed very little importance on performance measurement and capacity planning.

  - Overall financial resources of the company involved may play a role. Financially bouyant companies appear to be putting greater resources into these functions.

  - If any pattern emerged it was an unquantifiable one having to do with corporate and personal styles.

    . Some companies plan and believe in planning, others don't or can't.

    . Similarly, some individuals within a company (especially within a data processing organization) strongly believe in measurement and planning. However, the corollary is that when such people leave their position, the impetus for measurement and planning may die out.

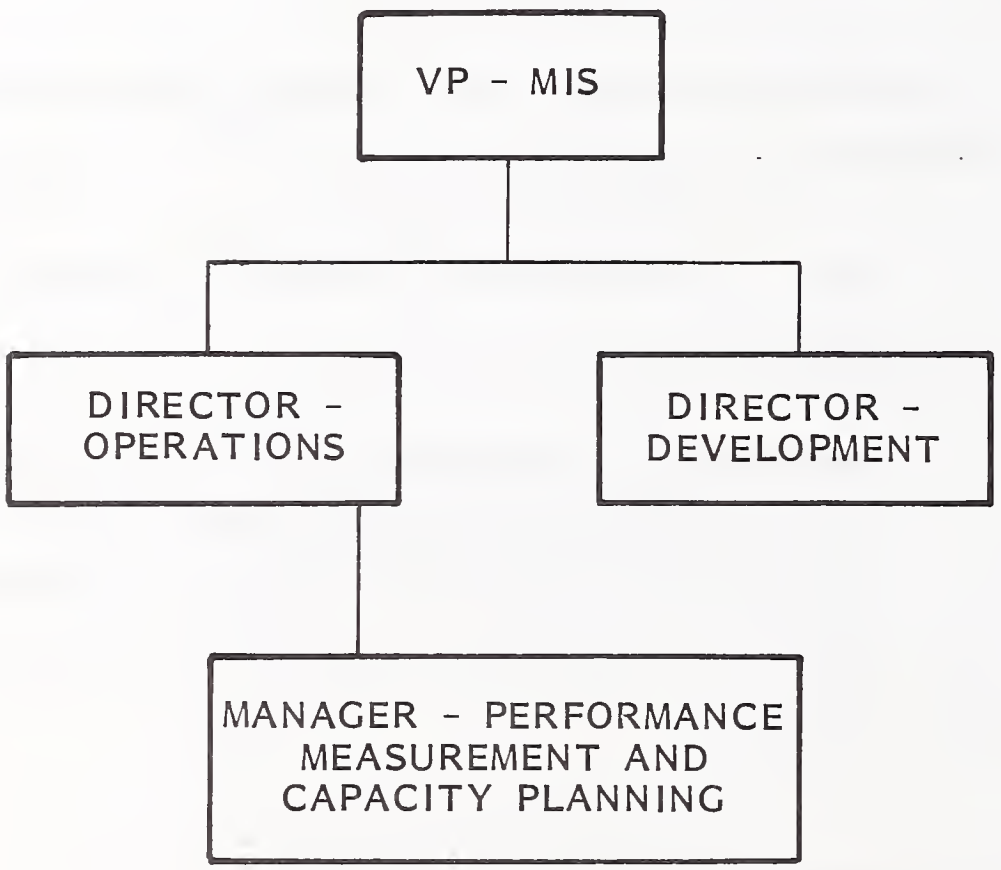
A. ORGANIZATIONAL ISSUES

- No single approach is taken to organize performance measurement and capacity planning. However, the relationships shown in Exhibit IV-2 reflect the typical approach.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-2

CAPACITY PLANNING ORGANIZATION: TYPICAL CURRENT STRUCTURE



©1981 by INPUT. Reproduction Prohibited.

INPU
U-SPE

- Justification for this approach is tool-driven: measurement tools are largely in the domain of systems programming, therefore the function that uses these tools should be also.

- An alternative organization used by several installations is to include capacity planning within their MIS planning unit. (Of course, many installations have only a vestigial planning function.)

- Of perhaps greater near-term importance than the organizational placement is the number of people assigned to performance measurement and capacity planning. Often there is an insufficient level of personnel resources assigned to these functions.

- This is an inescapable problem in all but the largest installations. Exhibit IV-3 shows the average size of staff assigned to performance measurement and capacity planning by installation size.

  - On the average, larger installations had three times as many personnel resources assigned to these functions. But:

    . Two-thirds of the respondents had fewer than two people assigned to performance measurement and capacity planning.

    . Virtually none of the smaller installations had two or more people assigned to the functions.

    . Over half the smaller installations had no full-time staff assigned to the functions.

- What is the minimum effective number of staff required for effective performance measurement and capacity planning?

  - An experienced capacity planner within IBM has written, for example, that having two people <u>start</u> the performance measurement and

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-3

STAFF ASSIGNED TO PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

INSTALLATION SIZE	AVERAGE STAFF SIZE	STAFF SIZE RANGE	PERCENT WITH NO ASSIGNED STAFF	PERCENT OF INSTALLATIONS WITH TWO OR MORE FULL-TIME EQUIVALENTS
LESS THAN A 3033* (n = 15)	0.7	0-3	53%	13%
3033 OR LARGER* (n = 14)	2.7	0-8	21	55
TOTAL (n = 34)	1.6	0-8	35%	35%

* OR EQUIVALENT, SIZED BY CPU KOPS RATING

©1981 by INPUT. Reproduction Prohibited.

capacity planning process "would be the most reasonable requirement" (Bronner, IBM Systems Journal, Vol. 19, No. 1).

- Basic economics and priorities often dictate a more modest approach. However, installations which have only a single person assigned to performance measurement and capacity planning will not have a very effective operation:

  . During vacations and other absences (e.g., on crash projects) the functions will not be covered.

  . If and when the single person leaves for another job (whether within or outside the same company), performance measurement and planning will essentially have to start over again. This was observed in several companies interviewed.

  . Performance measurement and capacity planning call for a wide range of skills. It is unlikely that all the skills will be found to the same degree in the same person. It is even probable that a person will be deficient in critical areas (e.g., a person may be basically a systems programmer and not be applications-oriented).

  . Perhaps most important, having two or more persons working on performance measurement and capacity planning will provide for a diversity of points of view, constructive criticism, and error avoidance. A process of internal review is most important if the resulting technical proposals are to be well thought out and grounded in reality. Otherwise, performance tuning and capacity planning will be at best unbalanced and all too often subject to ill-judged enthusiasms, as well as just plain mistakes.

©1981 by INPUT. Reproduction Prohibited.

- Judged by this reasoning, most companies are currently condemned to an ineffective program of performance measurement and capacity planning due to a lack of resources.

  - Perhaps part of the reason for the relatively low importance of performance measurement and capacity planning in some companies is that the program does not produce results sufficient to justify itself. (In at least a few of the companies interviewed, the low importance given the functions was a direct cause of their lack of resources.)

- There are indications that more resources are now being allocated to these functions.

  - In several companies, the functions had just been initiated or greatly expanded.

  - In others, these were plans to expand them.

  - In no company were there indications that the functions were to be reduced in scope.

B. PERFORMANCE MEASUREMENT

1. USE OF JOB ACCOUNTING REPORTS

- Over 70% of installations interviewed use a job accounting system, with smaller installations somewhat less prone to use one, as shown in Exhibit IV-4.

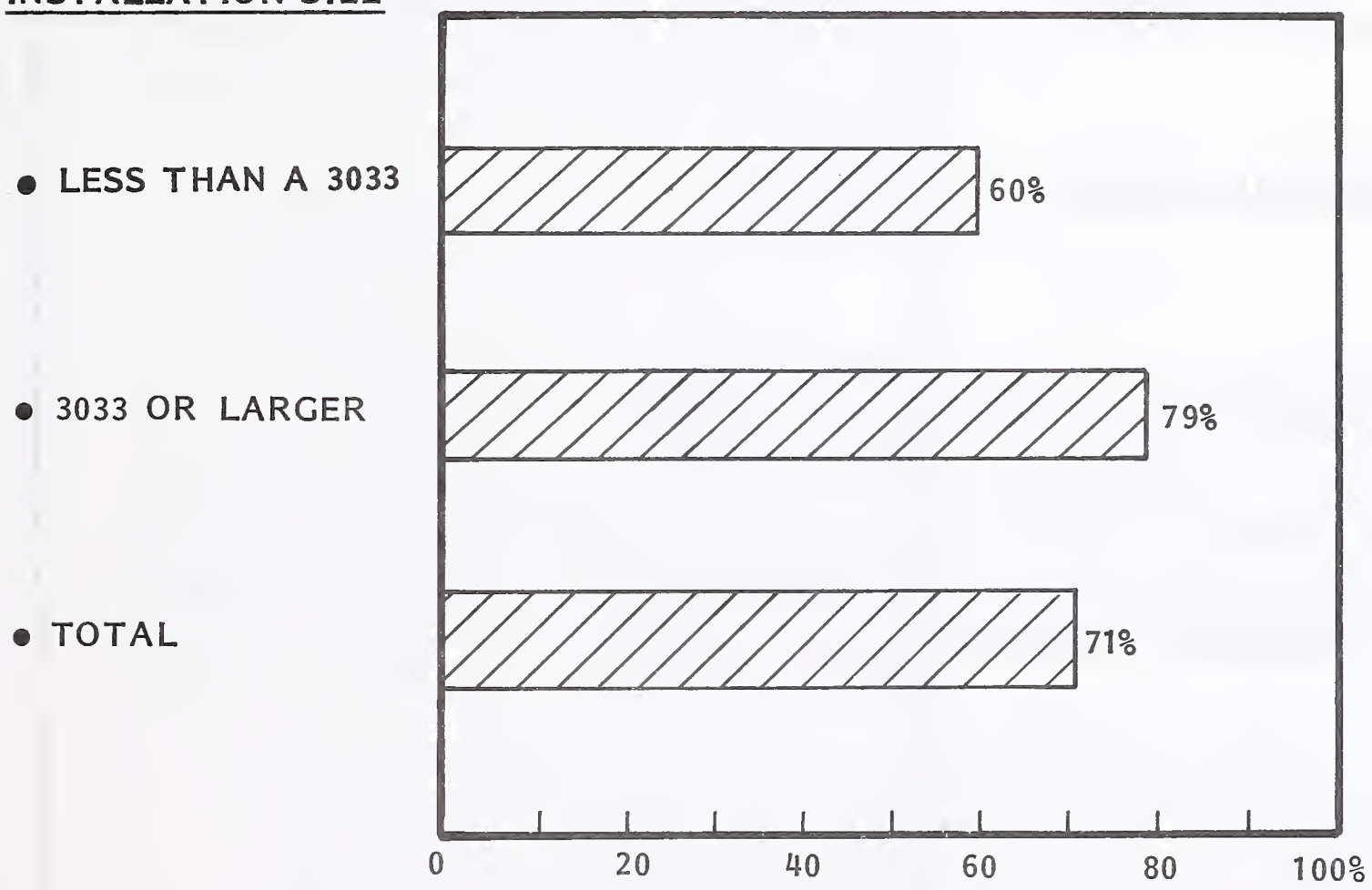
- About as many installations use a "homegrown" system as use a commercial package, as shown in Exhibit IV-5.

  - One-seventh of those interviewed use a manual system.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-4

USE OF JOB ACCOUNTING SYSTEMS BY INSTALLATION SIZE

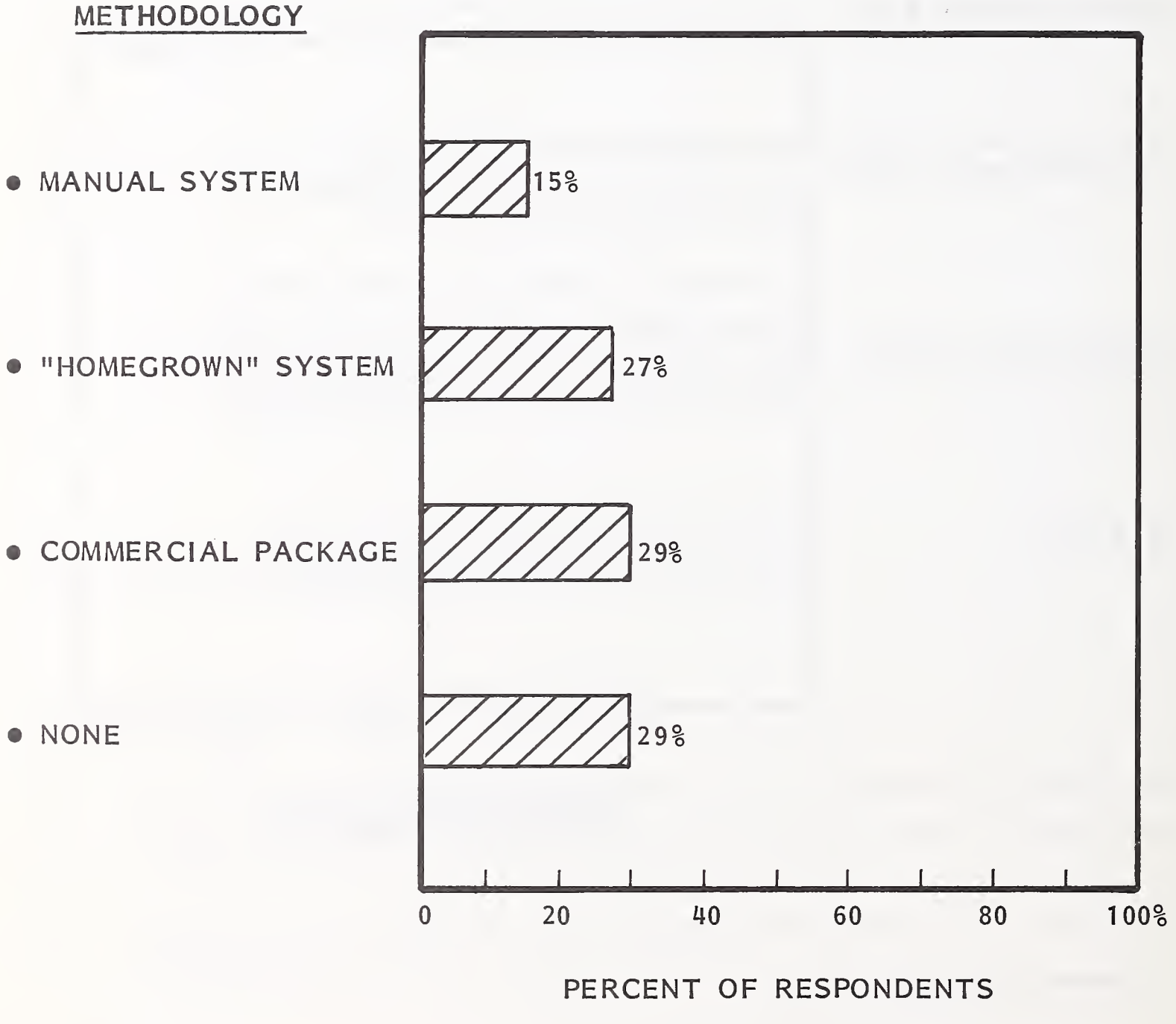


NUMBER OF RESPONDENTS = 34

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-5

JOB ACCOUNTING METHODOLOGIES



NUMBER OF RESPONDENTS = 34

©1981 by INPUT. Reproduction Prohibited.

- The particular interest in job accounting from the standpoint of this study is because some firms view job accounting as a form of performance measurement. (Note in the following subsection that a significant number of firms' only source of performance measurement is job accounting data.)

2. USE OF PERFORMANCE MEASUREMENT TOOLS

- Almost all installations use at least one type of measurement tool, as shown in Exhibit IV-6. Two-thirds use more than one tool.

- The most common single approach is to use RMF/SMF data directly, as shown in Exhibit IV-7, although software packages (job accounting package, monitors, and other software) are used more if looked at as a unit.

  - Hardware monitors are in place in a small minority of installations interviewed.

  - A small minority also use manual methods.

- It is difficult to see much of a pattern in the use of measurement tools. In Exhibit IV-8, sites are arranged in ascending order of size (ranked by CPU KOPS rating) and the major categories of measurement methodologies are listed for each site.

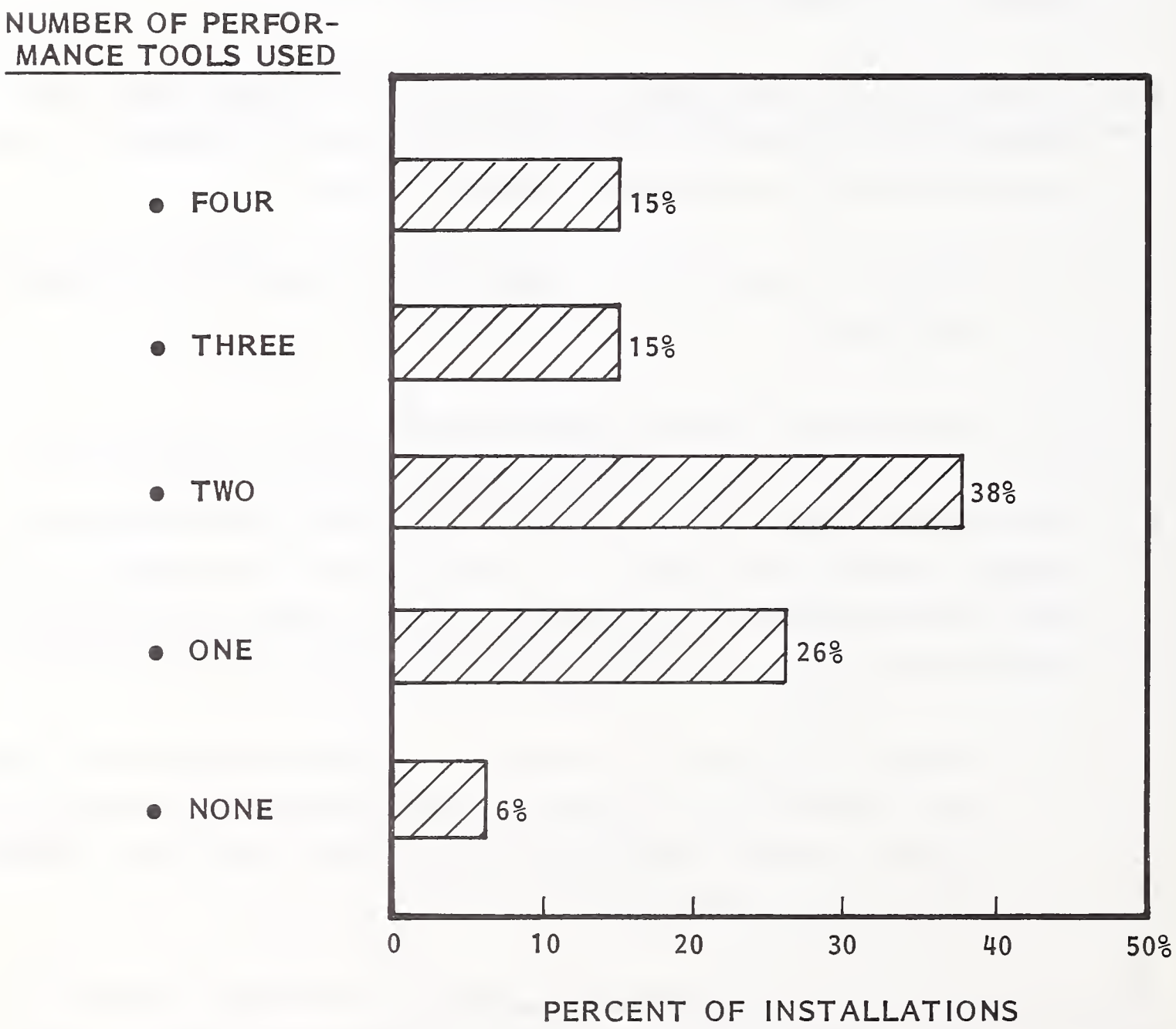
  - There do not appear to be strong relationships between types of tools used, installation size, or the size of the performance measurement and capacity planning staff, except that the biggest sites tend to perform more functions themselves.

  - The concurrent methodologies used are summarized in Exhibit IV-9. Again, no particular pattern of interrelationships between methodologies emerges.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-6

NUMBER OF PERFORMANCE MEASUREMENT TOOLS USED PER INSTALLATION

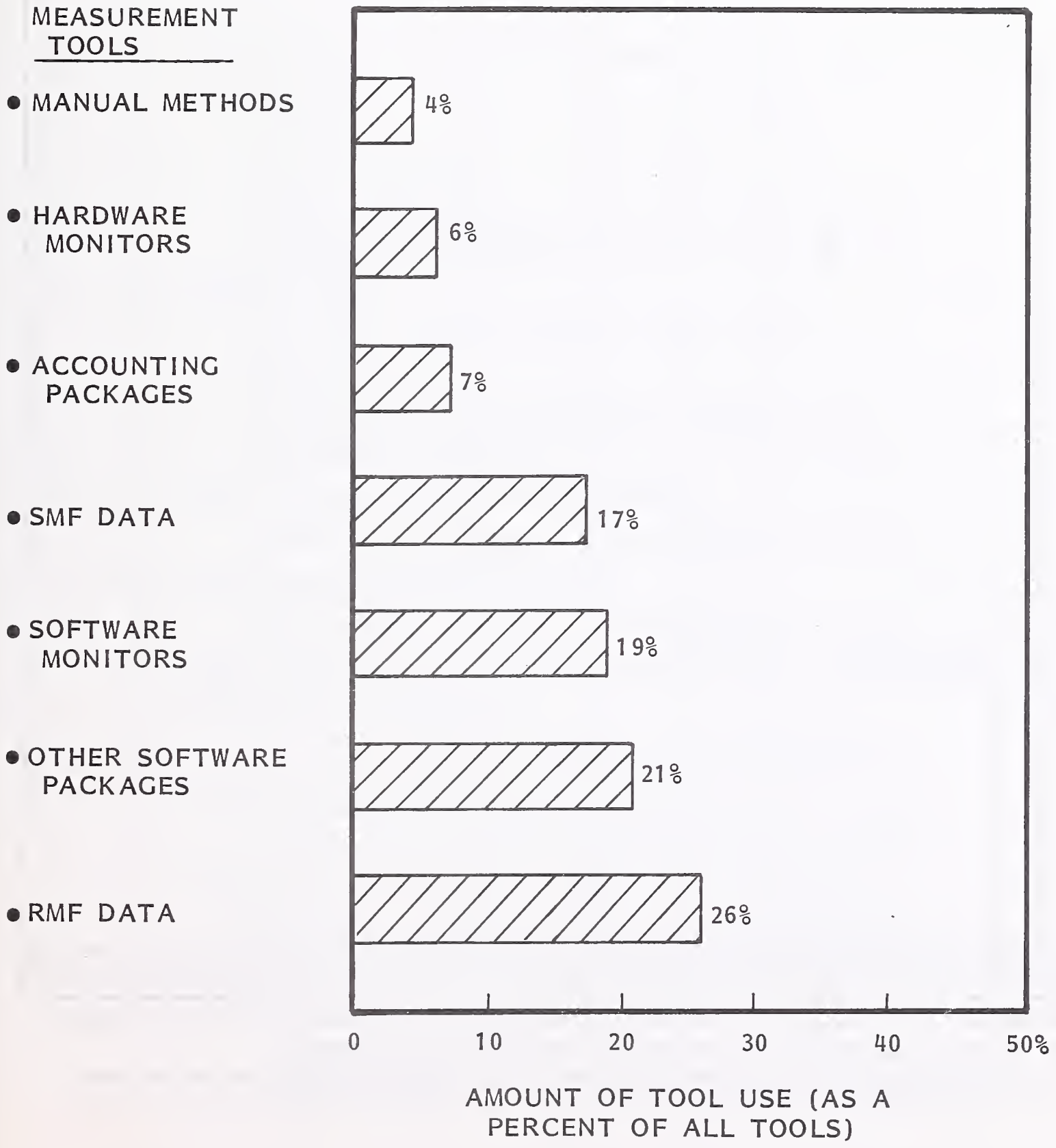


NUMBER OF RESPONDENTS = 34

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-7

RELATIVE USE OF DIFFERENT MEASUREMENT TOOLS



NUMBER OF RESPONDENTS = 34

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-8

MEASUREMENT METHODOLOGIES EMPLOYED

STAFF SIZE*	JOB ACCOUNTING PACKAGE**	SMF DATA	RMF DATA	STATISTICAL FRONT END TO SMF/RMF	SOFTWARE MONITOR	OTHER SOFTWARE	HARDWARE MONITOR	MANUAL TECHNIQUE	TOTAL TOOLS USED
1	X	–	–	–	–	X	–	–	2
0	–	–	–	–	–	X	–	–	1
0	–	–	–	–	–	X	–	–	1
0	–	–	–	–	–	–	–	X	1
0	–	–	X	X	–	–	–	–	2
0	–	–	–	–	–	–	–	–	0
3	–	–	X	X	–	–	–	–	2
0	–	–	X	–	–	–	–	–	1
1	X	–	–	–	–	–	–	–	1
0	X	–	X	X	–	X	–	–	4
1	–	X	–	–	–	X	–	–	2
0	–	–	–	–	–	–	X	–	1
3	–	X	X	X	–	X	–	–	4
1	–	X	–	X	X	–	–	–	3
1	–	X	–	–	–	–	–	–	1
0	–	–	–	–	X	–	–	X	2
4	–	–	–	–	–	–	–	X	1
1	–	–	X	–	X	–	–	–	2
0	–	X	X	X	X	–	–	–	4
2	–	X	–	–	–	–	X	–	2
3	–	X	X	X	X	–	–	–	4
1	–	–	X	–	–	–	–	–	1
0	X	–	X	–	X	–	–	–	3
0.5	–	–	X	–	X	–	–	–	2
2	–	–	–	–	X	–	X	–	2
1	X	X	X	–	X	–	–	–	4
5.5	–	–	X	–	–	X	X	–	3
1	–	X	–	–	X	–	–	–	2
4	–	X	X	–	X	–	–	–	3
3	–	–	X	–	X	–	–	–	2
2	–	–	X	–	X	–	–	–	2
0	–	–	–	–	–	–	–	–	0
8	–	X	X	–	–	–	–	–	2
5	–	X	X	–	–	X	–	–	3
TOTALS	5	12	18	7	13	8	4	3	70

*NUMBER OF PEOPLE ASSIGNED TO PERFORMANCE MEASUREMENT AND CAPACITY PLANNING FUNCTIONS.

**IF THE JOB ACCOUNTING PACKAGE IS USED FOR PERFORMANCE MEASUREMENT.

NOTE: SITES ARRANGED IN ORDER OF INCREASING SIZE, AS MEASURED IN CPU RATING IN THOUSANDS OF OPERATIONS PER SECOND (KOPS). EACH LINE REPRESENTS ONE SITE.

©1981 by INPUT. Reproduction Prohibited.

INPU
U-SPE

EXHIBIT IV-9

CONCURRENT MEASUREMENT METHODOLOGIES

- 12 SMF USERS
  - FOUR USE A STATISTICAL "FRONT END"
  - SEVEN USE RMF
  - NINE USE ANOTHER SOFTWARE PACKAGE OR HARDWARE MONITOR
- 18 RMF USERS
  - SIX USE A STATISTICAL "FRONT END"
  - SEVEN USE SMF
  - 12 USE ANOTHER SOFTWARE PACKAGE OR HARDWARE MONITOR
- FIVE ACCOUNTING PACKAGE USERS
  - FOUR USE ANOTHER METHODOLOGY AS WELL
- 13 SOFTWARE MONITOR USERS
  - ALL 13 USE ANOTHER METHODOLOGY AS WELL
- EIGHT USERS OF OTHER SOFTWARE, (e.g., SCHEDULERS, REPORTING PACKAGES)
  - SIX USE ANOTHER METHODOLOGY AS WELL
- FOUR HARDWARE MONITOR USERS
  - THREE USE ANOTHER METHODOLOGY AS WELL
- THREE USERS OF MANUAL ANALYSIS METHODS
  - ONE IN CONJUNCTION WITH A SOFTWARE PACKAGE

©1981 by INPUT. Reproduction Prohibited.

- To a certain extent, the mixture of tools reflects tools "inherited" from departed measurement specialists, where the incoming specialist prefers to use a different tool.

- Appendix D lists a number of performance measurement software tools.

3. RESULTS OF PERFORMANCE MEASUREMENT

- About two-thirds of installations felt that they had already experienced improvements in throughput and response time by system tuning as a result of performance measurement, as shown in Exhibit IV-10. One-third of installations (in both areas) also anticipated future improvements.

- The average improvement for those who could quantify improvements was said to be around 50% for both throughput and response time, with about one-seventh of installations seeing improvements of over 100%, as shown in Exhibit IV-11.

  - It is somewhat disturbing that one-quarter of the installations could offer no quantification, given that the benefit was supposed to be a direct outcome of performance measurement.

- While the improvements reported are in line with some of those reported in the literature, it is INPUT's opinion that these figures should be treated with caution:

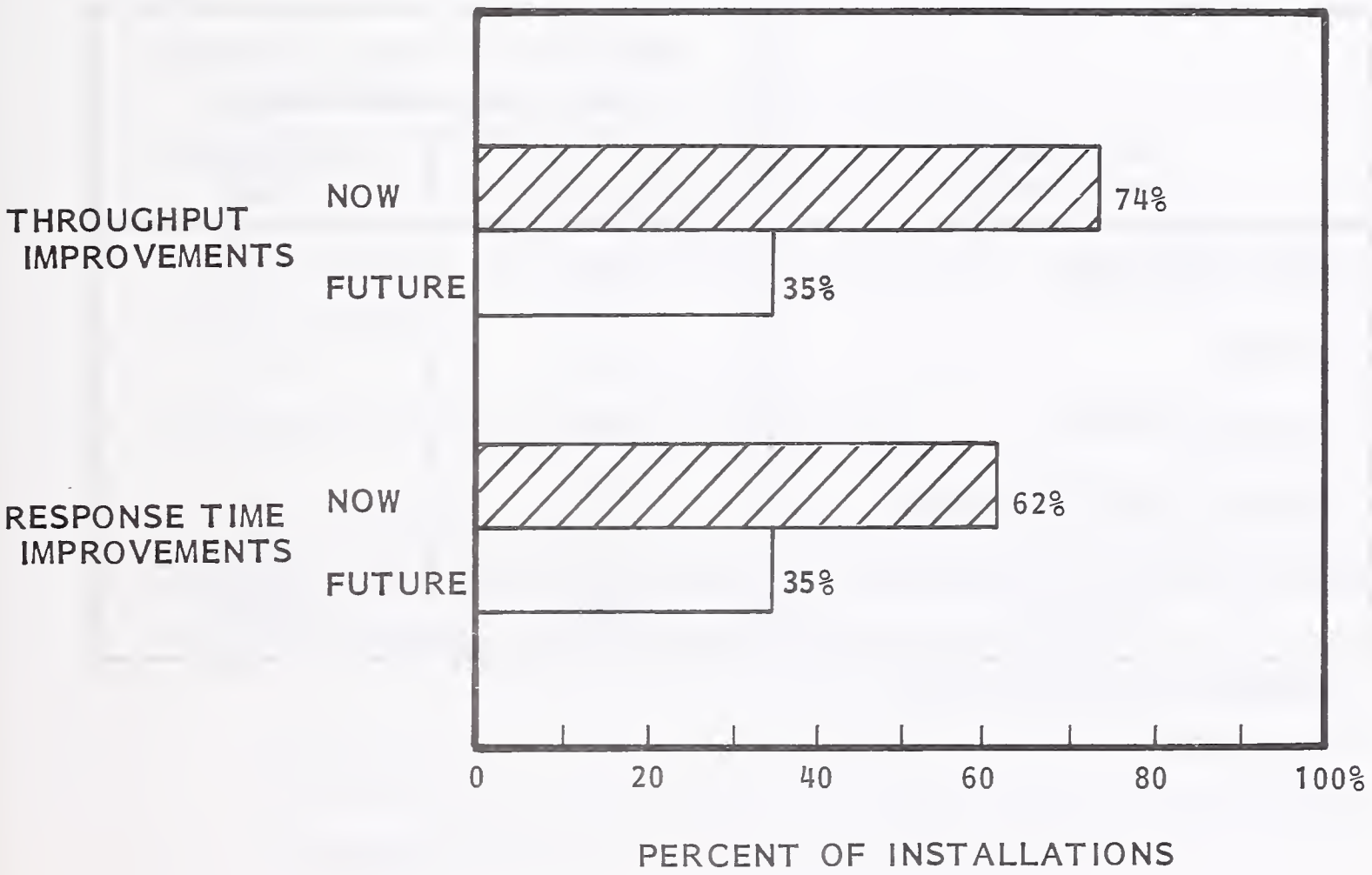
  - Many of the respondents gave figures described as "estimates"; in other cases, the manner in which replies were given implied that the figures were estimates.

  - In some interviews, the bases for the numbers were probed. They appeared in most cases to be the result of isolated measurements that may or may not have been representative. There were very few installations with reliable, comprehensive baseline data. Several

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-10

RESPONDENTS' REPORTED AND ANTICIPATED
IMPROVEMENTS IN THROUGHPUT AND RESPONSE TIME



NUMBER OF RESPONDENTS = 34

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-11

EXTENT OF IMPROVEMENT IN THROUGHPUT AND RESPONSE TIME

PERCENT IMPROVEMENT	PERCENT OF INSTALLATIONS THAT SAW IMPROVEMENT	
	THROUGHPUT	RESPONSE TIME
100% AND OVER	16%	14%
50-99%	8	29
49% AND UNDER	52	34
AMOUNT UNDETERMINED	24	24
TOTAL	100%	100%

NUMBER OF RESPONDENTS = 34

©1981 by INPUT. Reproduction Prohibited.

respondents commented on the difficulty of tracking and characterizing a "moving target."

- These difficulties were confirmed by several performance software vendors; this is significant, since it is certainly in the vendors' interest to be able to document case histories of successful uses of performance software.

- While performance measurement software is considered quite important, the satisfaction over its use is lower than its importance, as shown in Exhibit IV-12.

  - In the case of larger installations, importance is seen as higher and satisfaction as lower than in smaller installations.

- A fair conclusion is that improvements in performance measurement software are still required.

4. PERFORMANCE MEASUREMENT PROBLEMS

- The lack of focus on the use of measurement tools, described earlier, is consistent with the dissatisfaction and with the more basic problems observed during the interviews (and confirmed in discussions with vendors).

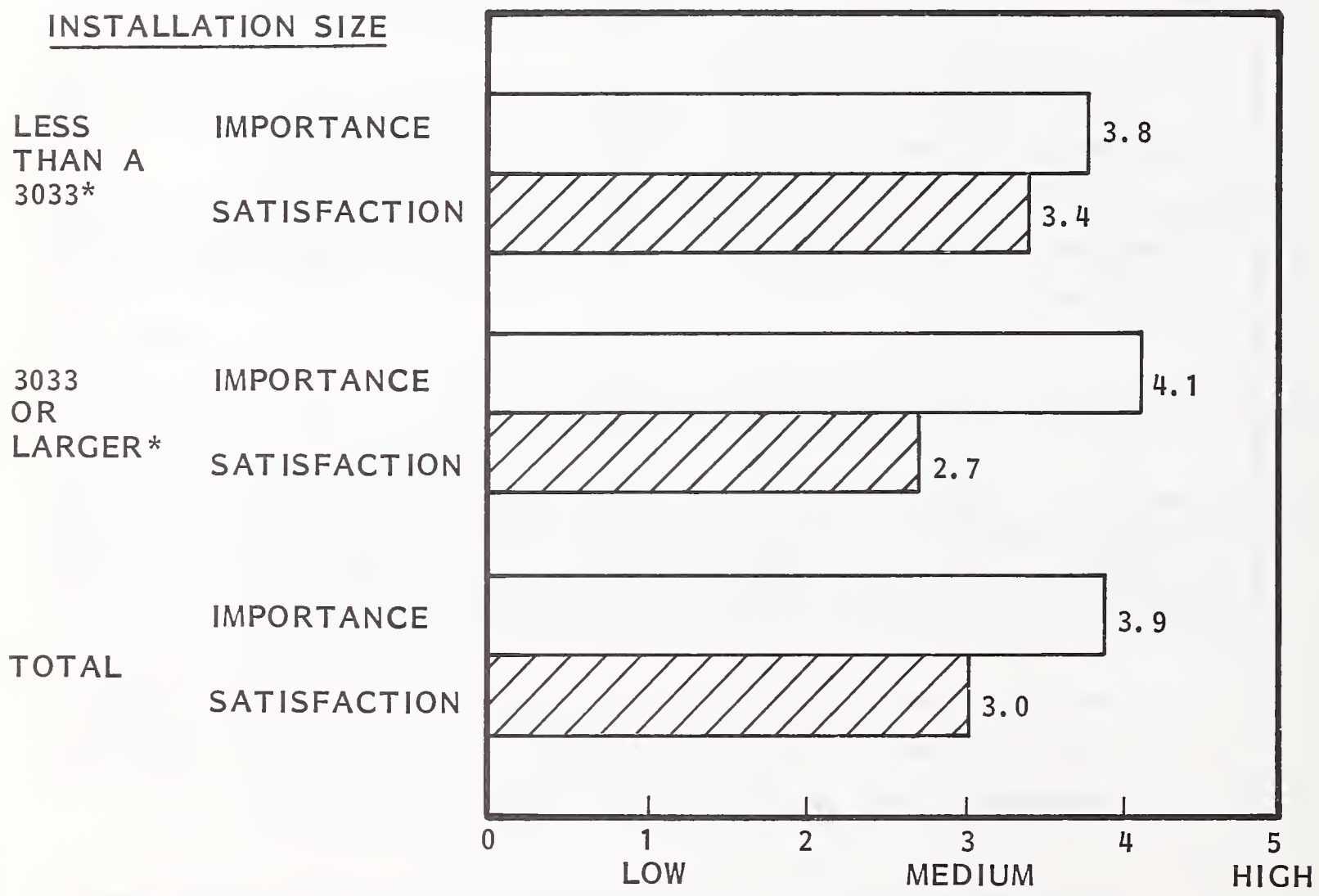
  - Most firms do not have a systematic approach to performance measurement; the users of tools are not sure what they are to be measuring, consequently they are often unsure of the right tool to use.

  - Many performance measurement specialists do not have a broad view of the field and some have not yet received enough training to select the right tool.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-12

JOB ACCOUNTING AND PERFORMANCE PACKAGE - IMPORTANCE AND SATISFACTION



NUMBER OF RESPONDENTS = 31

*OR EQUIVALENT, SIZED BY CPU KOPS RATING

©1981 by INPUT. Reproduction Prohibited.

- The organizations with no performance measurement specialists are in a worse position than those where the specialists have received even inadequate training.

  . In both cases, inappropriate tools may very well be selected. For example, installations that are relying primarily on job accounting data for performance measurement (one-quarter of those interviewed) will be missing some very important measurements.

- Even where valid data are being collected, a recurring complaint is that the data are not being used effectively:

  - "We generate tons of data, but don't know what it means." One installation had accumulated 150 reels of tape containing SMF/RMF data and didn't know how to proceed!

  - Variations on the following reply were received from several respondents when asked of their plans for acquiring additional software: "We know we aren't using our present tools to their fullest."

- A warning flag, at the very least, should be raised over the fact that so many companies (over half those interviewed) process their own RMF data.

  - This is not unexpected, given the predilection of many systems programmers to do things their own way. However, systems programmers have a much higher tolerance for detail than management.

  - There is also an element of reinventing the wheel. Software packages at least have the virtue of concentrating and focusing their reporting considerably (although more progress could be made).

- It is striking that the dissatisfaction is relatively high in the installations that, by and large, have the more adequate staffs and resources. In INPUT's

©1981 by INPUT. Reproduction Prohibited.

opinion, this reflects the fact that they have acquired enough knowledge to be aware of how much they still do not know.

C. CAPACITY PLANNING

1. THE PLANNING PROCESS

- Over two-thirds of installations interviewed have workload targets, as shown in the top line of Exhibit IV-13. Almost as many try to project five years into the future as try to project six months.

  - Many of those who had five-year projections expressed great doubt as to the worth of such an exercise, but explained that it was necessary as part of their capital equipment budgeting process.

  - Almost two-thirds of those with targets said that they met their six-month targets and almost half said that they met the five-year targets, as shown in the second line of Exhibit IV-13.

- It is fair to say that in a number of cases the stated success in meeting targets represented as much a hope as a reality.

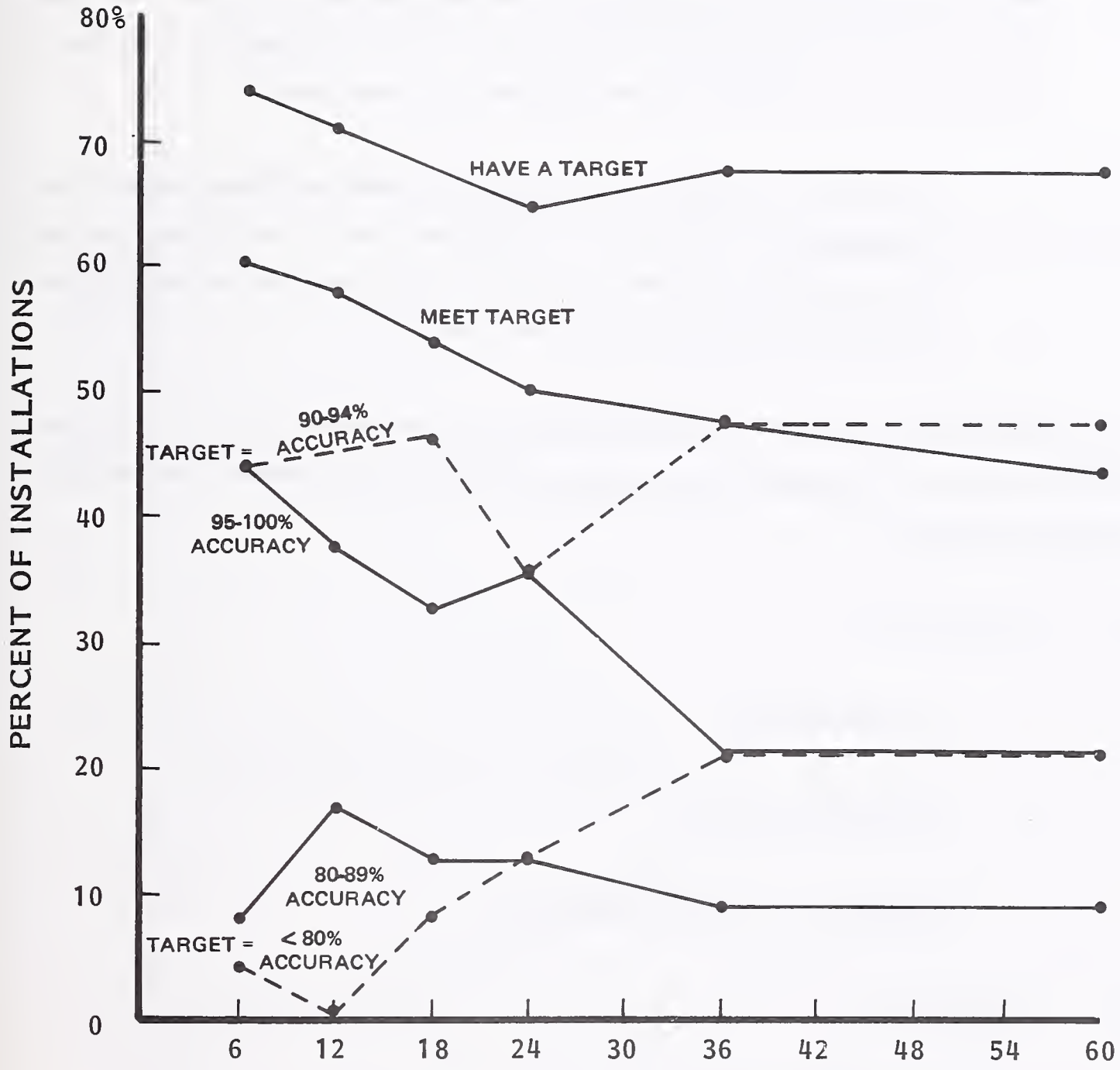
  - Two-thirds said that they had very stringent targets; i.e., over 90% accuracy in projecting targets five years into the future, as shown in the middle portion of Exhibit IV-13.

  - It was apparent that some respondents really had qualitative measures of success in mind; e.g., "I'm not aware of any disasters and I haven't lost my job, so we must be meeting targets" (implicit in several interviews).

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-13

WORKLOAD PLANNING TARGETS AND SUCCESS IN MEETING THEM



©1981 by INPUT. Reproduction Prohibited.

- A few respondents made obviously contradictory responses in the course of the interview; e.g., one installation that claimed success in meeting high accuracy targets discussed how one large machine had been sitting virtually idle for an extended period of time. It was obvious in that case that the respondent was excluding from accuracy assessments events over which, in his opinion, his department had no direct control.

- Most importantly, as discussed in the previous section, most installations do not have accurate short-term (not to speak of long-term) baseline data on which to make judgments of workloads.

  . Consistent workload and capacity baseline measurement are certainly very difficult to maintain over a multiyear period, given ongoing changes in machine configurations and qualitative changes in the nature of the workload.

- It is quite likely that many installations still have an implicitly batch-oriented mental picture of workload and capacity. Exhibit IV-14 shows two ways of viewing capacity.

  - View "A" is:

    . Inward-looking.

    . Process-oriented.

    . Defined by computer resources.

  - View "B" is:

    . Outward-looking.

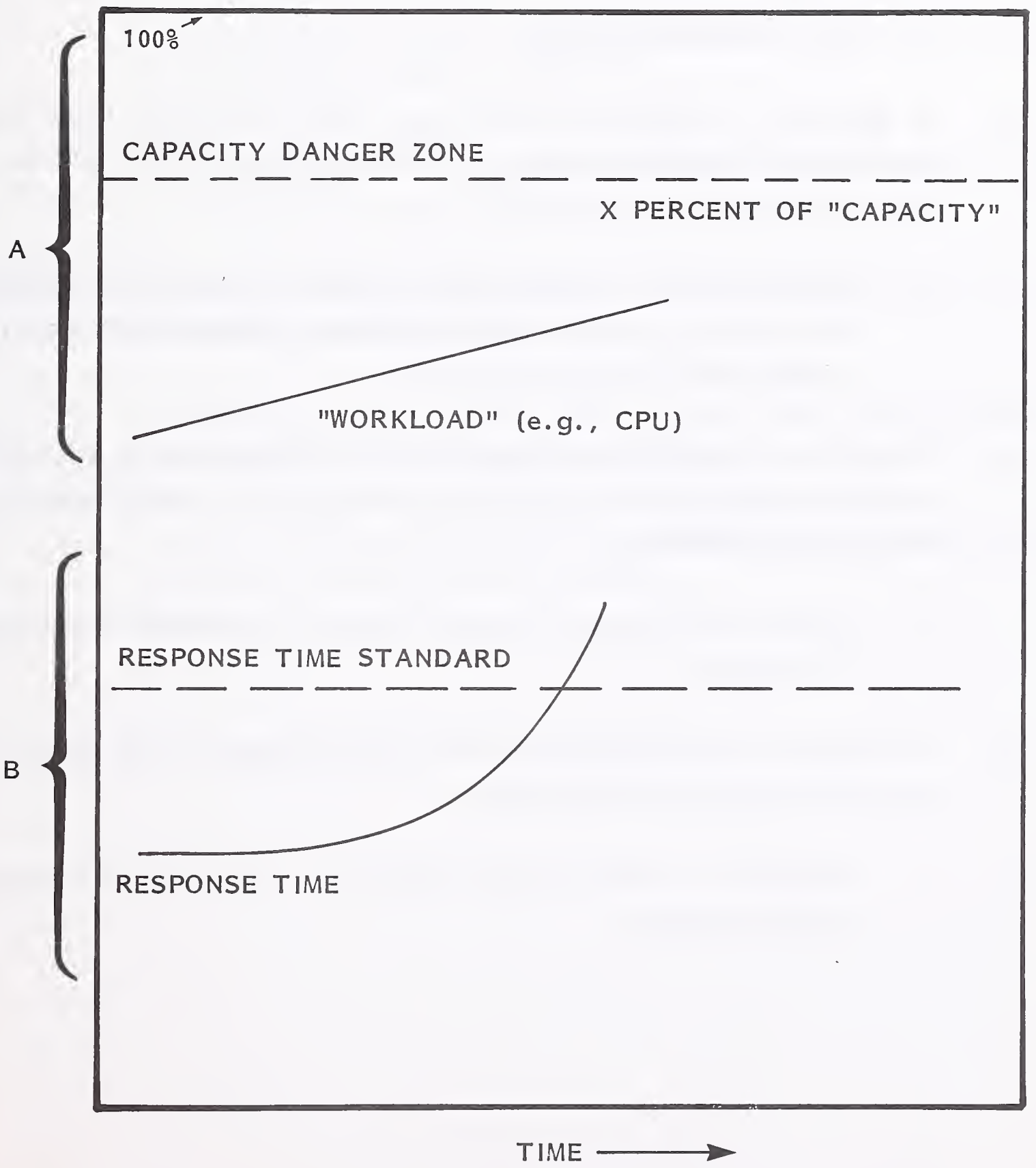
    . Results-oriented.

    . Defined by user needs.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-14

TWO VIEWS OF CAPACITY



©1981 by INPUT. Reproduction Prohibited.

- However, view "A" is still respected; in the literature as well as in INPUT's interviews, CPU time is still often used as the point of reference because:

  - It is relatively easy to measure.

  - It can be equated from machine to machine (although perhaps not as easily as sometimes believed).

  - It is a traditional measure.

- In deference to modernity, rather than a 90% CPU overall target being established for planning purposes, some installations now have a 30% (or so) level established for the prime shift.

  - However, such a surrogate does not take into account the possibility that interactive system performance can be degraded for a variety of reasons other than CPU constraints.

- A handful of installations interviewed now view response time as the critical measure on which they were basing their planning efforts. Several others were moving in that direction.

  - Success will probably be limited, however, until baseline measurement is improved.

- Two-thirds of the installations reported that estimates of user demand are part of the capacity planning process.

  - However, in most cases this consists only of estimating transaction volume increases.

©1981 by INPUT. Reproduction Prohibited.

2. CAPACITY PLANNING TOOLS

- Few installations are using special tools for capacity planning, in contrast to performance measurement, as shown in Exhibit IV-15.

- Others are in the experimentation stage, but there is a general dearth of knowledge on the subject.

  - Two-thirds were unable to name any (or any additional) capacity planning tools, as shown in Exhibit IV-16.

  - This is partly explained by the relatively few tools now available and their relatively low penetration.

- It is doubtful if capacity planning can be effective without the use of specialized capacity planning tools.

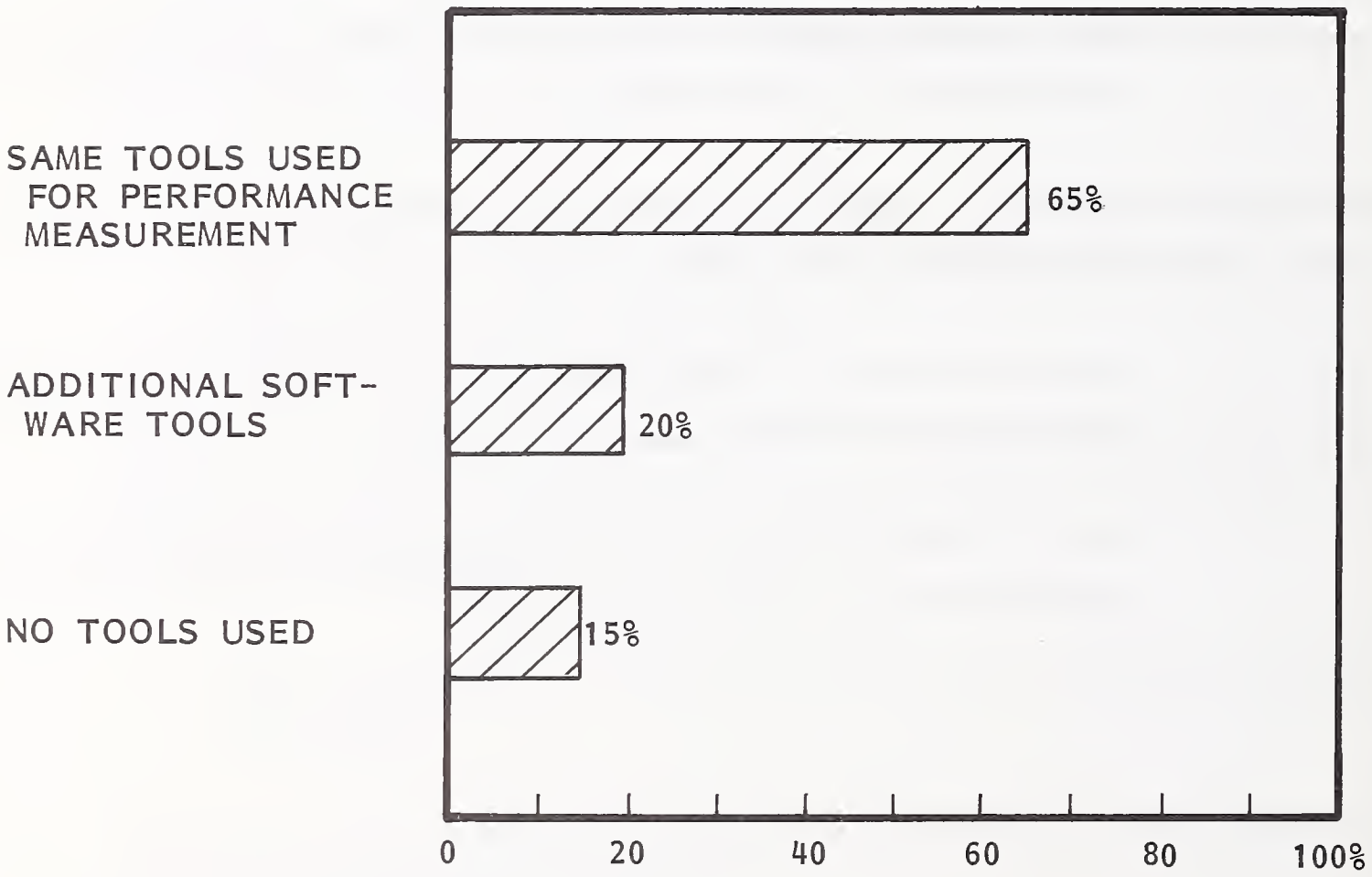
  - Statistical trending methods based on past history, while straightforward, will not reflect important realities.

  - Manual methods will be too slow and imprecise and will not permit any significant amount of sensitivity analysis.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-15

CAPACITY PLANNING TOOLS NOW EMPLOYED

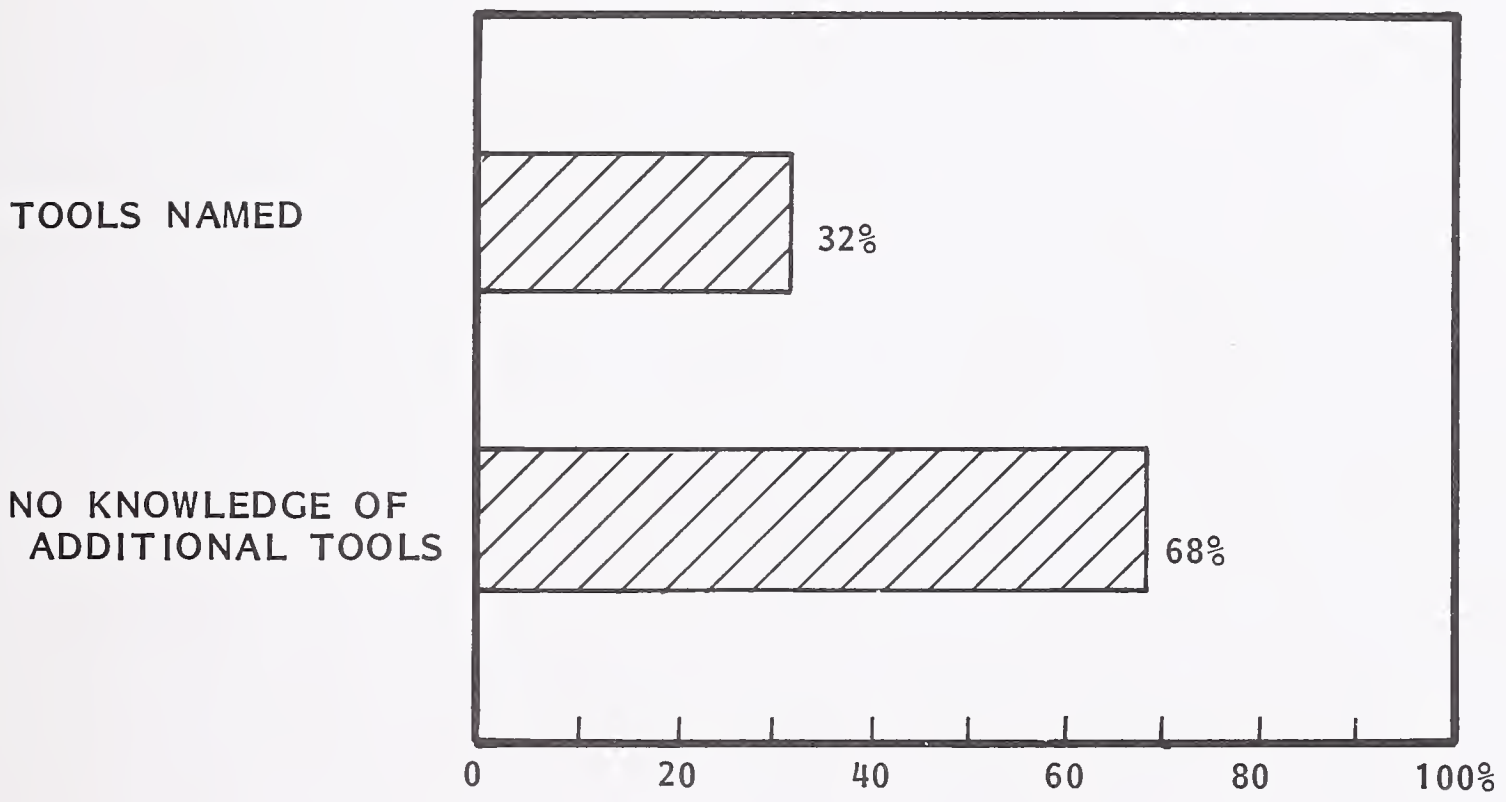


NUMBER OF RESPONDENTS = 34

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT IV-16

KNOWLEDGE OF ADDITIONAL CAPACITY PLANNING TOOLS AVAILABLE



NUMBER OF RESPONDENTS = 34

©1981 by INPUT. Reproduction Prohibited.

V TRENDS

V TRENDS

- Two trends are important for MIS management to keep informed of:
  - Trends within, or perceived by, data processing installations.
  - Trends within the vendor community.

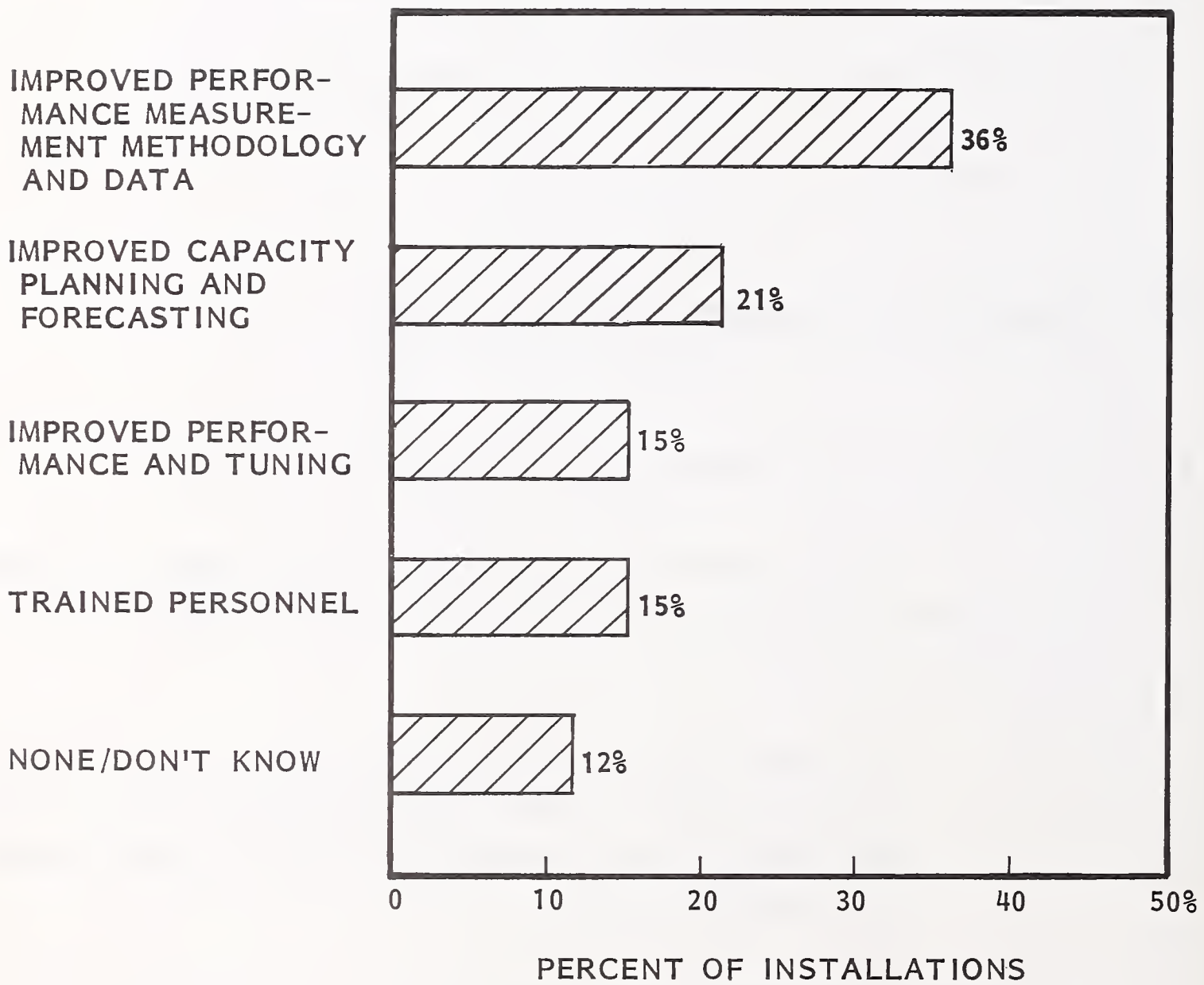
A. TRENDS IN DATA PROCESSING INSTALLATIONS

- One important way of predicting trends is to identify unmet needs.
  - Over half the installations interviewed saw their biggest need being improved methodologies for measurement and planning, as shown in Exhibit V-1.
    - The greater need was seen in performance measurement; this is reasonable, given the many current problems in this area and that good performance measurement is the necessary precondition to capacity planning.
  - Improved performance/tuning and trained personnel were also seen as key needs by 15% of those interviewed.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT V-1

LARGEST UNMET NEED



NUMBER OF RESPONDENTS = 34

©1981 by INPUT. Reproduction Prohibited.

- Exhibit V-1 should be viewed as a good overall list of priorities. It should be kept in mind that all these items are important issues (and were important in the minds of most respondents).

- A majority of installations interviewed saw an increase in importance for performance measurement and capacity planning as being the most significant trend over the next five years in these areas, as shown in Exhibit V-2.

  - Another quarter saw primarily technical trends.

  - A very small number saw closer involvement in business planning as being of primary importance.

- It is quite likely that this response is so prevalent because:

  - There is a sense of increased interest and activity in the general area that has not yet reached its peak.

  - In many cases, there is both a lack of reflection on specific causative factors and a lack of knowledge of the external environment.

- One issue that the study explored in some depth was whether falling hardware prices would lessen the need for capacity planning (and performance measurement, for that matter).

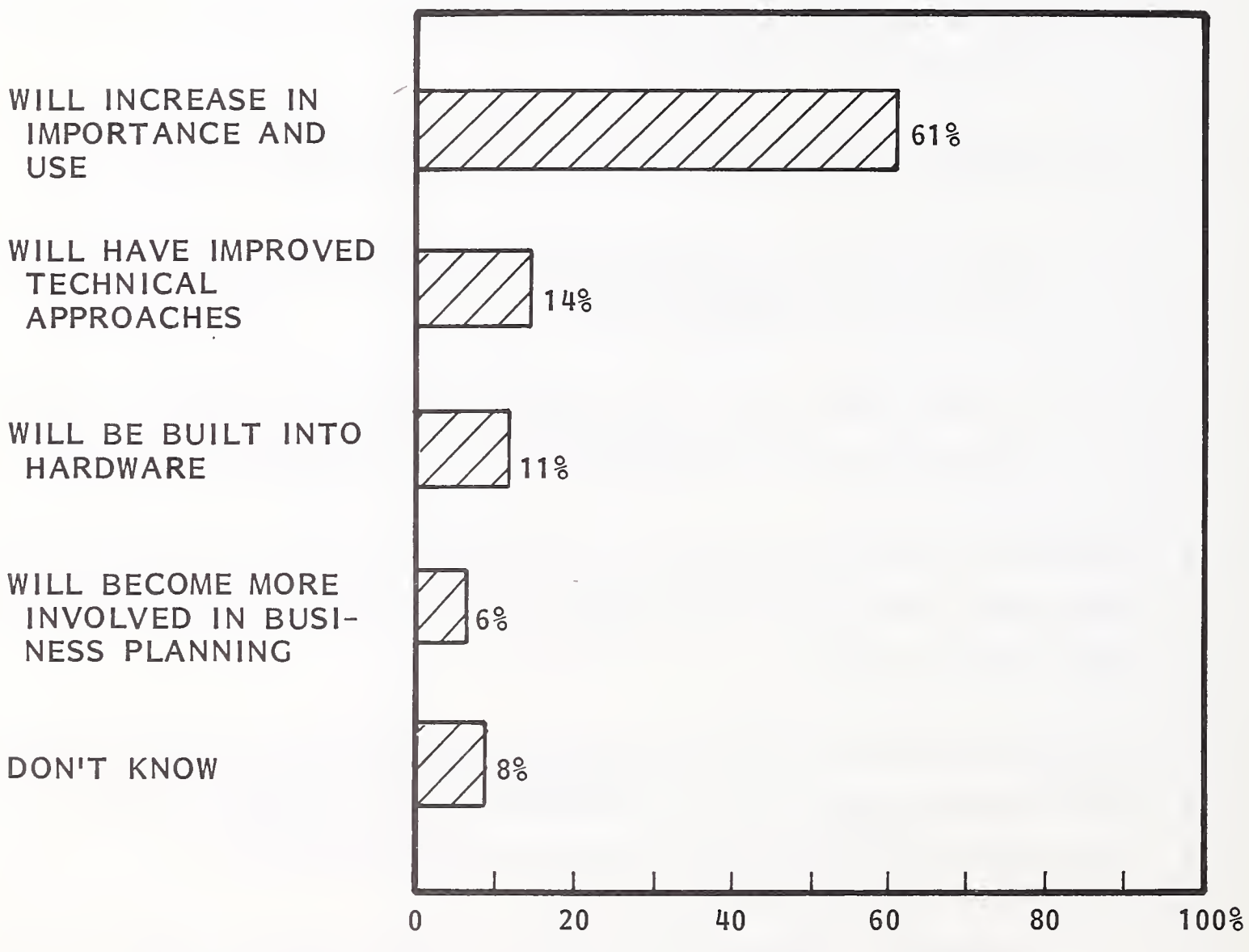
- It is quite significant that almost half the installations saw falling hardware prices requiring more in the way of capacity planning, as shown in Exhibit V-3. The reasons given fall into two categories, as shown in Exhibit V-4.

  - Increases in software prices will at least partially offset falling hardware prices.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT V-2

TRENDS FORESEEN IN PERFORMANCE MEASUREMENT AND CAPACITY PLANNING IN THE NEXT FIVE YEARS

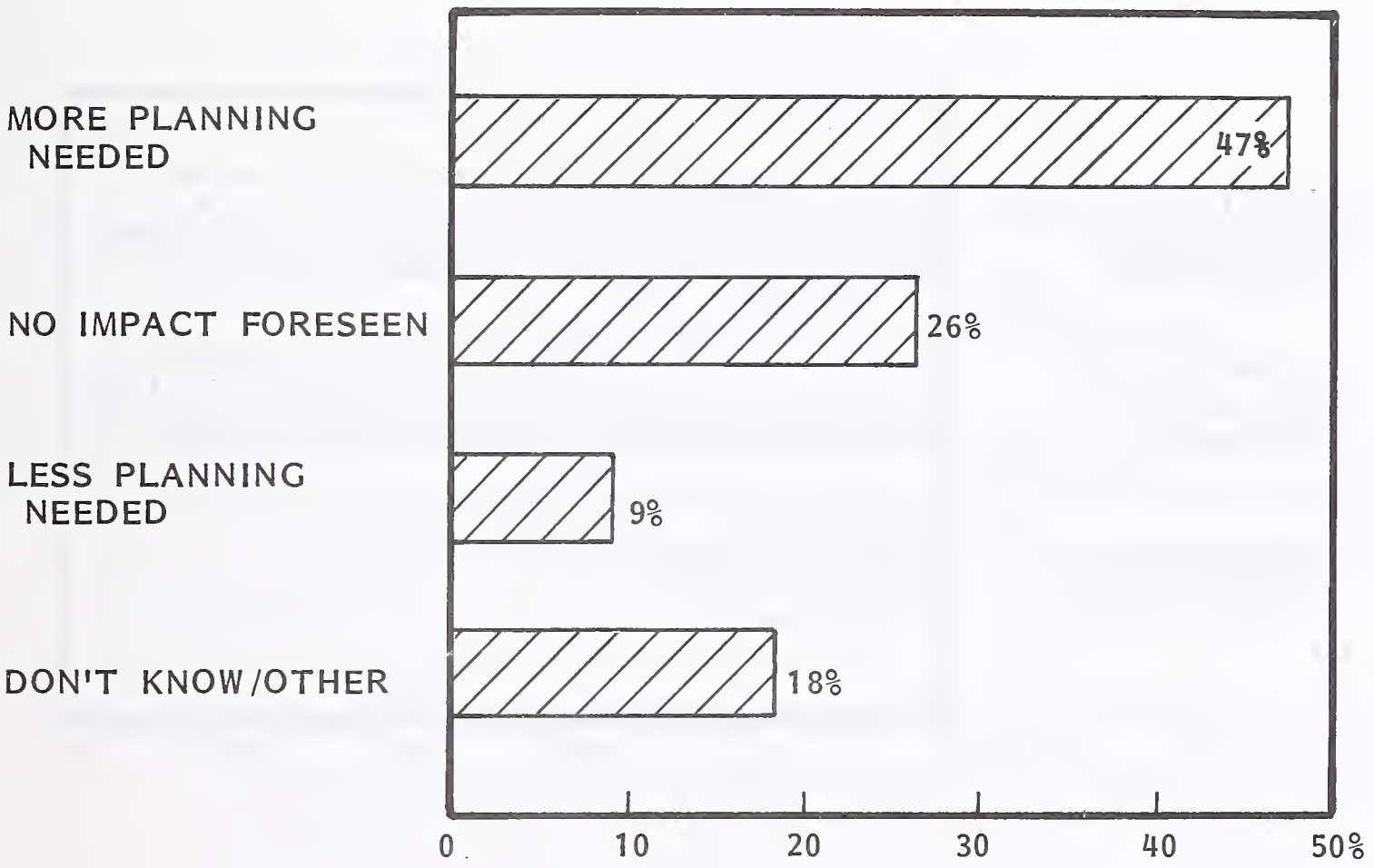


NUMBER OF RESPONDENTS = 35

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT V-3

IMPACT FORESEEN OF FALLING HARDWARE PRICES ON CAPACITY PLANNING

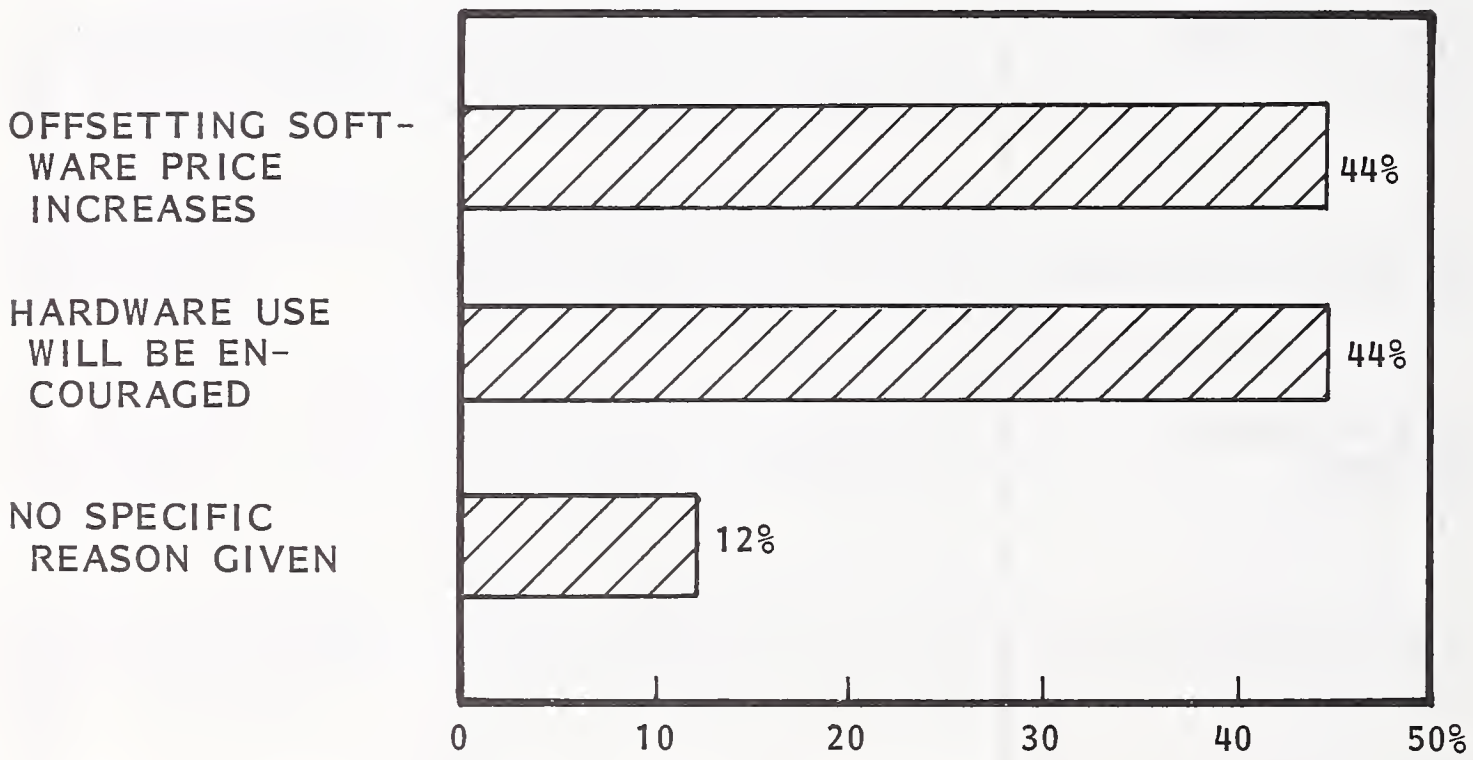


NUMBER OF RESPONDENTS = 35

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT V-4

REASONS WHY FALLING HARDWARE PRICES WILL REQUIRE MORE PLANNING



NUMBER OF RESPONDENTS = 35

©1981 by INPUT. Reproduction Prohibited.

- Falling hardware prices will stimulate computer use, causing total expenses to continue to rise. These relationships are shown in Exhibit V-5.

- Other issues explored were standalone user-operated systems and distributed data processing. The responses were similar in both areas, as shown in Exhibit V-6.

  - About one-quarter of installations saw planning becoming more complex for both areas.

  - About one-third saw use increasing, with the effects on planning unclear (half saw DDP in this light).

    . It would probably be fair to characterize this group as hoping that there will be no impact from these - but having to admit that there will in fact possibly be a substantial impact.

- INPUT received a strong impression during the interview process that most installations were not (and did not feel) ready to begin measuring and planning for a dispersed data processing environment (whether standalone or distributed).

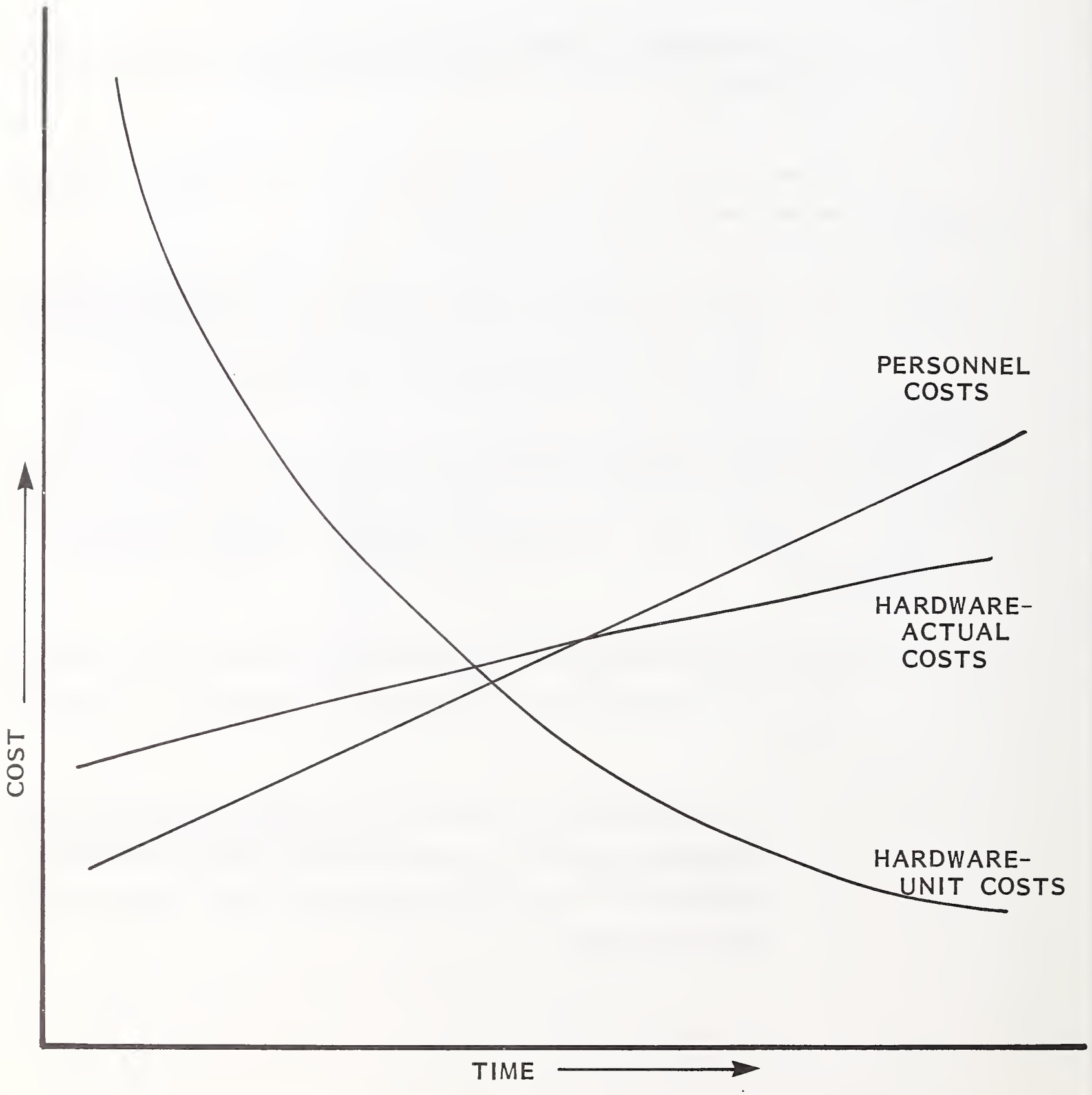
  - However, the interplay between standalone and central data processing functions will become much more important - and complex - in the near future.

    . For example, INPUT's recent study, Personal Computers in Large Companies, forecasts a sevenfold rise in the use of personal computers by Fortune 500 companies by 1985 - often in critical application areas.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT V-5

DATA CENTER COSTS: SCHEMATIC

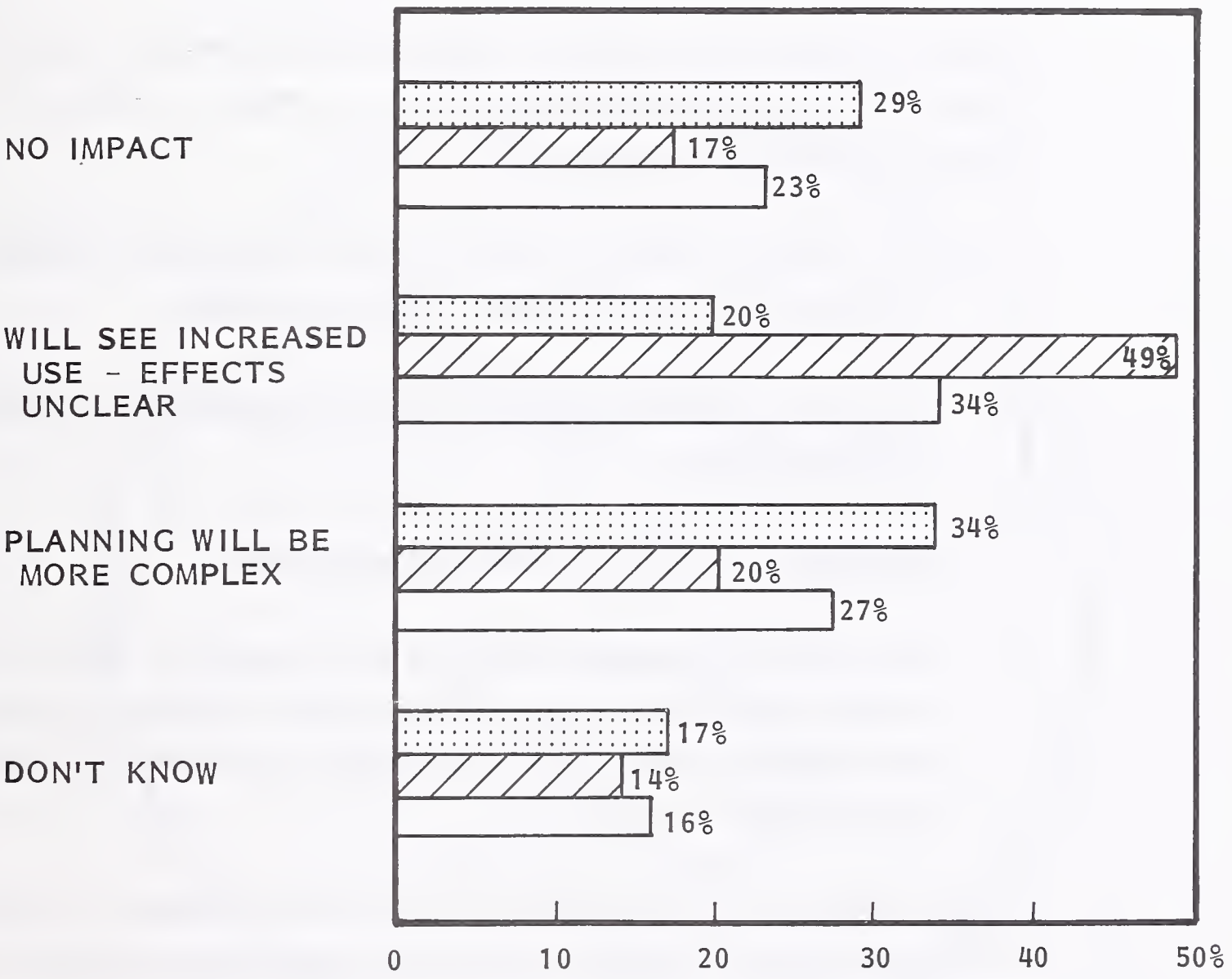


©1981 by INPUT. Reproduction Prohibited.

INPU
U-SPE

EXHIBIT V-6

IMPACT OF STANDALONE USER-OPERATED SYSTEMS AND DISTRIBUTED DATA PROCESSING ON CAPACITY PLANNING



NUMBER OF RESPONDENTS = 35

©1981 by INPUT. Reproduction Prohibited.

B. VENDOR TRENDS

- Vendors realize that their own products are part of the problem.

- There are now a large number of software products that generate a profusion of data. In the future, software products should better serve data processing installations in a number of ways:

  - Related products will be better integrated so that there is less user intervention and routine decision-making, as shown in Exhibit V-7. Examples of this trend already exist:

    . The related products offered by BGS (a monitor, program resource projector, and system resource projector).

    . CMF from Boole and Babbage (which is a consolidation of several earlier products).

    . The April 1980 SPARK release from Burroughs.

    . All indications are that this trend will accelerate. There is no reason, for example, why a single, modular software tool could not integrate performance measurement and reporting functions with capacity planning.

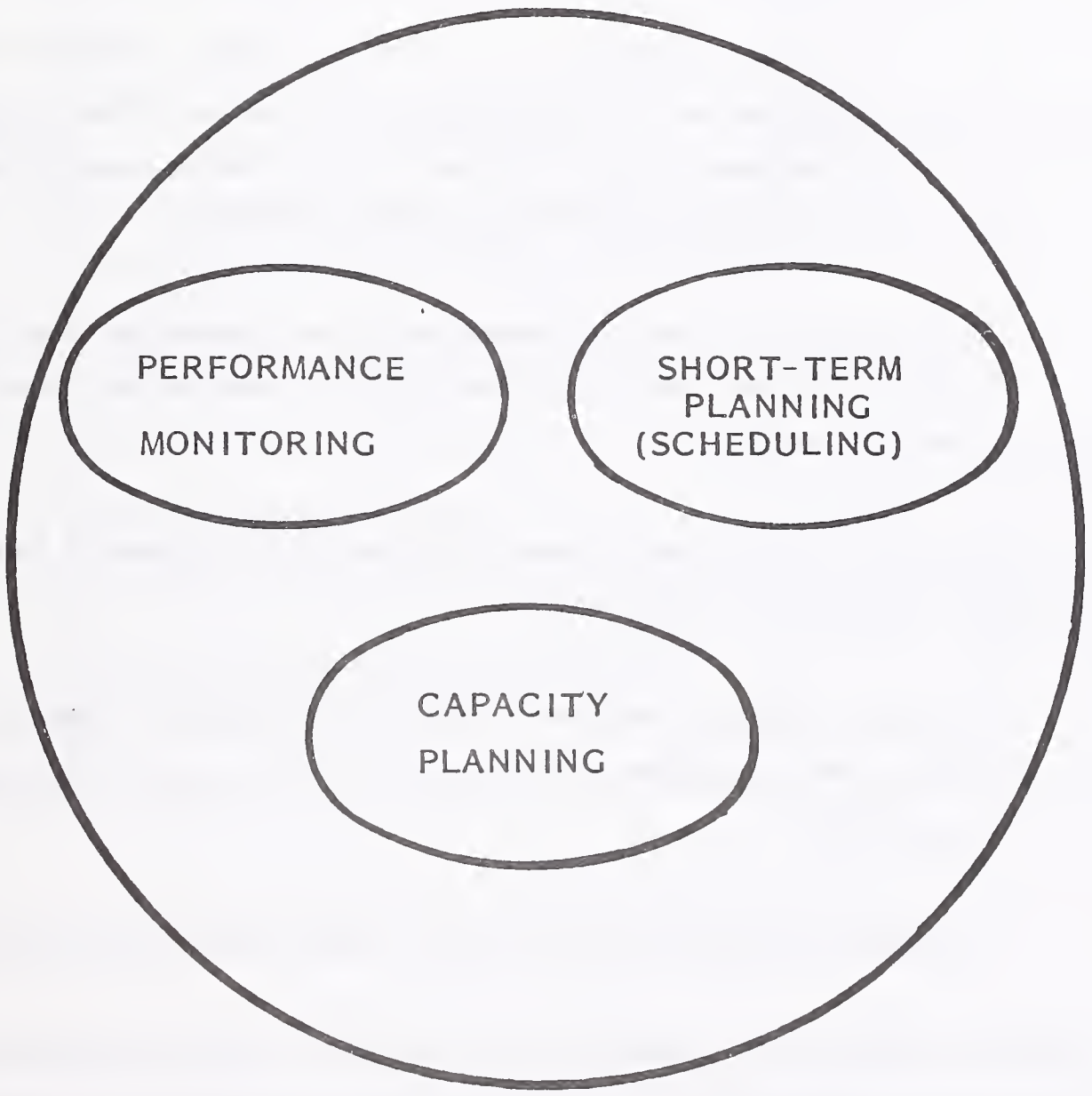
  - Future software should be able to take corrective action by itself (within predetermined bounds) rather than, at best, issue warnings, as is now the case.

  - A distinction has grown up between batch and on-line software monitors.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT V-7

INTEGRATION OF
MEASUREMENT AND PLANNING



©1981 by INPUT. Reproduction Prohibited.

- Batch monitors accumulate log data, perhaps daily, and produce reports showing the contrasts between relatively recent and historic performance.

- On-line monitors show, via a CRT, what is happening at a particular instant, but do not compare that instant to historic data.

- Some on-line monitors (e.g., ADR's LOOK) do accumulate data being collected for later batch-type reporting.

- The next generation of monitors would allow for real-time interrogation of historic files. This would allow, for example, the automatic corrective action, described above, to use historic experience as one of the control parameters.

- In the future, software packages will also provide for more extensive focused reporting that will guide users in establishing more effective exception reporting.

- It is useful to view software tools as potentially including a hierarchy of functions, as shown in Exhibit V-8.

  - Generally speaking, the batch monitor functions are toward the lower end of the spectrum (which can also be viewed as a necessary foundation).

  - The higher integrated levels are still in the process of development.

- Hardware monitors are a special case. They offer unique functions, but at the present time relatively few installations have progressed far enough to use them effectively or, in many instances, know that they might need a hardware monitor.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT V-8

HIERARCHY OF SOFTWARE
TOOL FUNCTIONS

LEVEL	FUNCTION	NOW OFFERED IN:	
		ON-LINE MONITORS	BATCH MONITORS
6	AUTOMATIC CORRECTIVE ACTION	-	-
5	AUTOMATIC WARNING FOR EXCEEDED PARAMETERS	SOME	-
4	EXCEPTION REPORTING	YES	SOME
3	FOCUSED REPORTING	SOME	YES
2	SUMMARIZED/ORGANIZED DATA	SOME	YES
1	INDISCRIMINATE/UNSELECTIVE DATA COLLECTION	-	YES

©1981 by INPUT. Reproduction Prohibited.

- As knowledge and familiarity with software monitors build up, more installations would be expected to explore the use of hardware monitors.

- An intriguing product would be a combined hardware-software monitor that would combine the advantages of both types of monitoring in a single package.

- Another possibility would be pulling back into microcode the monitoring functions that are now performed externally. With the absorption of other systems functions into firmware, this kind of transfer of functions is feasible.

  - One hardware company is considering offering a built-in hardware monitor as part of an approach to making performance measurement more effective and easier to use.

  - IBM could doubtless offer this capability if it was judged to be in IBM's interest to do so. The effects on other performance monitoring vendors would be profound. The benefits (if any) for data processing installations would depend on the way in which the facility was implemented and how much room was left for other vendors.

    . If IBM's handling of similar software issues is any guide, it is doubtful that there will be any rapid changes.

C. CAPACITY PLANNING COMPLEXITIES

- The previous two sections described many positive tendencies, insofar as the capabilities of data processing installations to better measure performance and plan capacity are concerned.

©1981 by INPUT. Reproduction Prohibited.

- However, INPUT expects to see a concomitant increase in the complexity and difficulty of carrying out effective capacity planning. Most of these factors have been discussed before and will just be mentioned here:

  - Increased use and importance of on-line systems.

  - Distributed data processing.

  - User standalone systems.

- Another development that only a few installations have fully experienced, but that most will be undertaking in the future, is user-controlled, interactive decision support systems (sometimes called the "wild what if").

  - The different components of a mature decision support system are shown in Exhibit V-9. Obviously, this is an application that will consume many computer system resources.

  - One aspect that should terrify data processing operations management is the unpredictability associated with a "what if" capability that can access a detailed operations data base.

  - In one reported case, a single "what if" exercise consumed 70% of the resources of an Amdahl V-7 system.

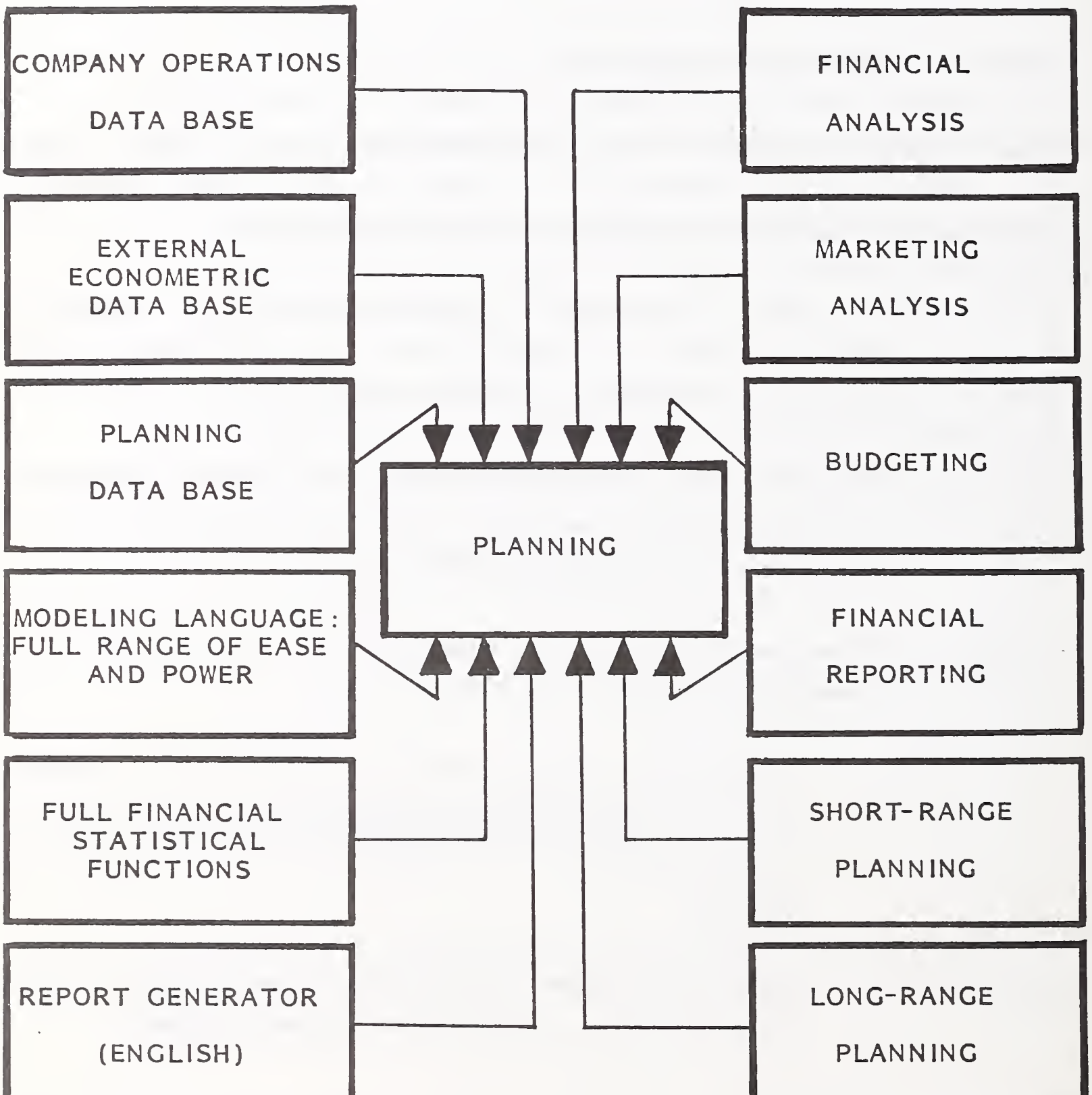
    . The exercise was not considered wasteful of computer resources (within the boundaries of what it wished to accomplish) and was a highly important piece of analysis that bore rich fruit for the company.

    . However, the magnitude of the request, and its potential impact on operations and on capacity planning, was unforeseen.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT V-9

INTEGRATED FINANCIAL REPORTING AND DECISION SUPPORT SYSTEMS



©1981 by INPUT. Reproduction Prohibited.

- This kind of "what if" exercise often has powerful top management sponsors so that, even where the analysis is pointless or uses computer resources very inefficiently, it may be hard to oppose.

  . Moreover, it is this kind of creative use of computing that MIS departments have been trying to encourage.

D. SUMMARY OF TRENDS

- In general, INPUT sees three distinct trends:

  - The capabilities of data processing installations for carrying out performance measurement and capacity planning will increase significantly. This will be brought about by a combination of:

    . Increased knowledge and skills.

    . Better tools.

  - The difficulties of projecting and controlling growth may also increase significantly.

  - The importance of and need for capacity planning will grow markedly. The factors causing this are listed in Exhibit V-10.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT V-10

FACTORS INCREASING IMPORTANCE OF CAPACITY PLANNING

- On-line production systems.
- Interactive program development.
- Lengthy hardware delivery times.
- Budget reductions, general economic pressures.
- Large, new, high-visibility applications.
- Major, ongoing enhancements to applications.
- Increased choice in hardware selection.
- Interactive user timesharing.
- Curvilinear base load demand increases.
- Distributed data processing.
- User standalone systems.
- Interactive decision support systems.

©1981 by INPUT. Reproduction Prohibited.

VI RECOMMENDATIONS

VI RECOMMENDATIONS

- Capacity planning issues may only occasionally be in the "you bet your company" class; however, the handling (or mishandling) of capacity planning can more often be a matter of "you bet your job," or at the least, may tarnish the reputation of the MIS department.

  - Mishandled capacity planning can result in:

    . Unpredicted expenditures for more equipment.

    . Loss of corporate business (or restricted opportunities) due to bad response time or inability to expand a network.

    . Delay in implementing a new application system.

- The recommendations given below are grouped into four categories.

  - General, or strategic, recommendations.

  - Organizational and structural recommendations.

  - Recommendations for identifying user intentions and satisfaction.

  - Tactical and methodological recommendations.

©1981 by INPUT. Reproduction Prohibited.

A. STRATEGIC RECOMMENDATIONS

- Determine the appropriate level of effort: The most important management decision is the level of effort that should be devoted to performance management and capacity planning. There are two principal factors here: resources availability and organizational acceptance.

  - The resource constraint is an obvious one, but it might be overlooked or slighted. On the most basic level, a small organization should not try to do all the things that a large company might attempt.

    . Resource constraints can be useful if they encourage a focused attack on problems and an identification of high-priority areas.

    . Other recommendations, below, will describe methods of focusing efforts.

  - Potential organizational acceptance is a less obvious issue, but can be the prime determinant of the program's success. To be quite frank, not all organizations are good candidates for a thoroughgoing program of performance measurement and capacity planning. This can be due to:

    . Personalities and "politics."

    . The nature of the business.

    . The level of organizational advancement of the MIS department.

  - The dominant personalities in some businesses are extremely mercurial and resistant to planning. Often very effective because of their instincts for commercial success, they nevertheless offer an inhos-

©1981 by INPUT. Reproduction Prohibited.

pitable climate for orderly, long-range planning. The best approach in this environment is to stay flexible and always have a considerable amount of excess hardware.

- Similarly, the nature of some businesses is quite variable, obeying no predictable pattern.

- Finally, the state of organizational advancement of the MIS department itself is a critical determinant of what can be expected from a program of performance management and capacity planning. Exhibit VI-1 (taken in simplified form from INPUT's recent study, Improving the Productivity of Systems and Software Implementation) shows the general stages of MIS development.

  . A quite different approach to performance measurement and capacity planning will be required at each stage.

  . At the "chaos" stage, for example, it is doubtful that a very effective program can be devised. Firefighting and a reactive mode will be the most that can be expected.

- Train data processing personnel: The state of knowledge in performance measurement and capacity planning is in flux and constantly advancing; most staffs are now inadequately trained. There are many sources of knowledge; the right ones to use will depend on the organization's current level of knowledge, geographic location, goals, budget, etc. Exhibit VI-2 lists and evaluates the main sources.

- Educate non-data processing management: Managers outside MIS must understand the importance of the general issues involved. This is necessary for two reasons:

  - The positive contribution and support they and their staff can provide will be critical.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT VI-1

STAGES OF DATA PROCESSING DEVELOPMENT

STAGE	CHARACTERISTICS AND RELATIONSHIP TO PRIOR STAGES
STAGE 0: CHAOS	Self-descriptive.
STAGE 1: CONTROL	The constant state of crisis (created by the chaos stage) demands efforts to bring EDP under control. These efforts may be brutal, using semi-arbitrary mechanisms. Rigid centralization is one method widely used.
STAGE 2: QUALITY	After control has been achieved, the mechanisms used to establish control are modified to take into account the demands for increasingly complex systems, more reliable and more attuned to user needs.
STAGE 3: EFFICIENCY	Quality DP systems raise interest throughout the organization in the potential for DP to increase the efficiency and effectiveness of the entire organization. Many productivity initiatives begin in the quality stage and are refined and expanded in the efficiency stage.
STAGE 4: VALUE	The efficiency stage raises expectations further, since user needs for information are met more predictably and information has critical value alongside the other factors of production. Data processing is no longer a separate, isolated activity but participates directly in the mainstream of corporate activities (as, for example, finance does now).

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT VI-2

SOURCES OF INFORMATION ON PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

SOURCE	COMMENT
INTERNAL DISCUSSIONS WITHIN THE COMPANY	The most important source after a minimum level of knowledge is attained.
INFORMAL DISCUSSIONS WITH COLLEAGUES IN THE COMPUTER COMMUNITY	Especially important for MIS management; must evaluate sources carefully.
PERFORMANCE/PLANNING SOFTWARE USER GROUPS	Can be on the leading edge. Danger: may be too oriented to technical details.
HARDWARE MANUFACTURER USER GROUPS	Good, especially for informal contacts and information exchange with other users.
PROFESSIONAL SOCIETIES	Valuable, if not too theoretical or rarified.
VENDOR BROCHURES AND SALES SEMINARS	A sometimes overlooked way of getting really good information from the front lines (they have seen it all); quality and depth vary.
SEMINARS	Good, if a particular seminar is based on extensive exposure to the field; some can be too general.
SOFTWARE DESCRIPTIVE REPORTS (e.g., ICP, DATAPRO SOFTWARE, EDP PERFORMANCE MANAGEMENT HANDBOOK)	Sketches of software products, very valuable for an initial review; all are basically non-evaluative. The Performance Management Handbook provides greater depth and a good overview section.

©1981 by INPUT. Reproduction Prohibited.

- The capacity planning group within MIS will be constantly requesting planning information and workload data from user departments. Much greater cooperation will be obtained if it is founded upon informed consent.

- Direct capacity planning from the top: MIS top management should take an active role in developing and evaluating the performance measurement and capacity planning program.

  - The key issues should not be considered technical: "War is too important to be left to the generals."

  - A well run, effective capacity planning program will strike to the heart of an enterprise's affairs.

  - MIS management will often, especially at the beginning, be called upon to mediate between operations, development, and user groups.

  - MIS management will be held directly accountable for failures in capacity planning.

B. ORGANIZATIONAL RECOMMENDATIONS

- Treat capacity planning as a generalized function: Performance measurement and capacity planning are linked in that one is a foundation for the other.

  - However, some of the components of the capacity planning process require a high degree of knowledge in the following areas:

    . Particular application systems.

©1981 by INPUT. Reproduction Prohibited.

. The organization's goals and functions.

. Techniques in management and control.

- No one area in the MIS department, least of all the systems programming area, will be able to produce the full package of skills required. Exhibit VI-3 shows a quantification of the types of knowledge required in these widely differing areas.

- Set up a task force: Because performance measurement and capacity planning are linked, generalized functions, a suitable organization structure may have to be specially developed.

- The typical approach (previously illustrated by Exhibit IV-2) of viewing the program as primarily technical is not satisfactory, except as an expedient for getting started.

- A better approach is to view capacity planning as a "task force" enterprise, as shown in Exhibit VI-4, with individuals specializing by function, but working as a unit.

. Personnel need not be full time. In many respects it is more desirable that they be part time (but at least one-third time) so that there is additional cross-fertilization. A part-time role is also desirable from a cost and backup standpoint.

- The task force could report to the director of planning, since the "higher" attributes of capacity planning tie into planning in general, as shown in Exhibit VI-5.

. Smaller organizations could have the capacity planning unit report directly to the MIS director.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT VI-3

AREAS OF KNOWLEDGE REQUIRED TO CARRY OUT

PERFORMANCE MEASUREMENT AND CAPACITY PLANNING

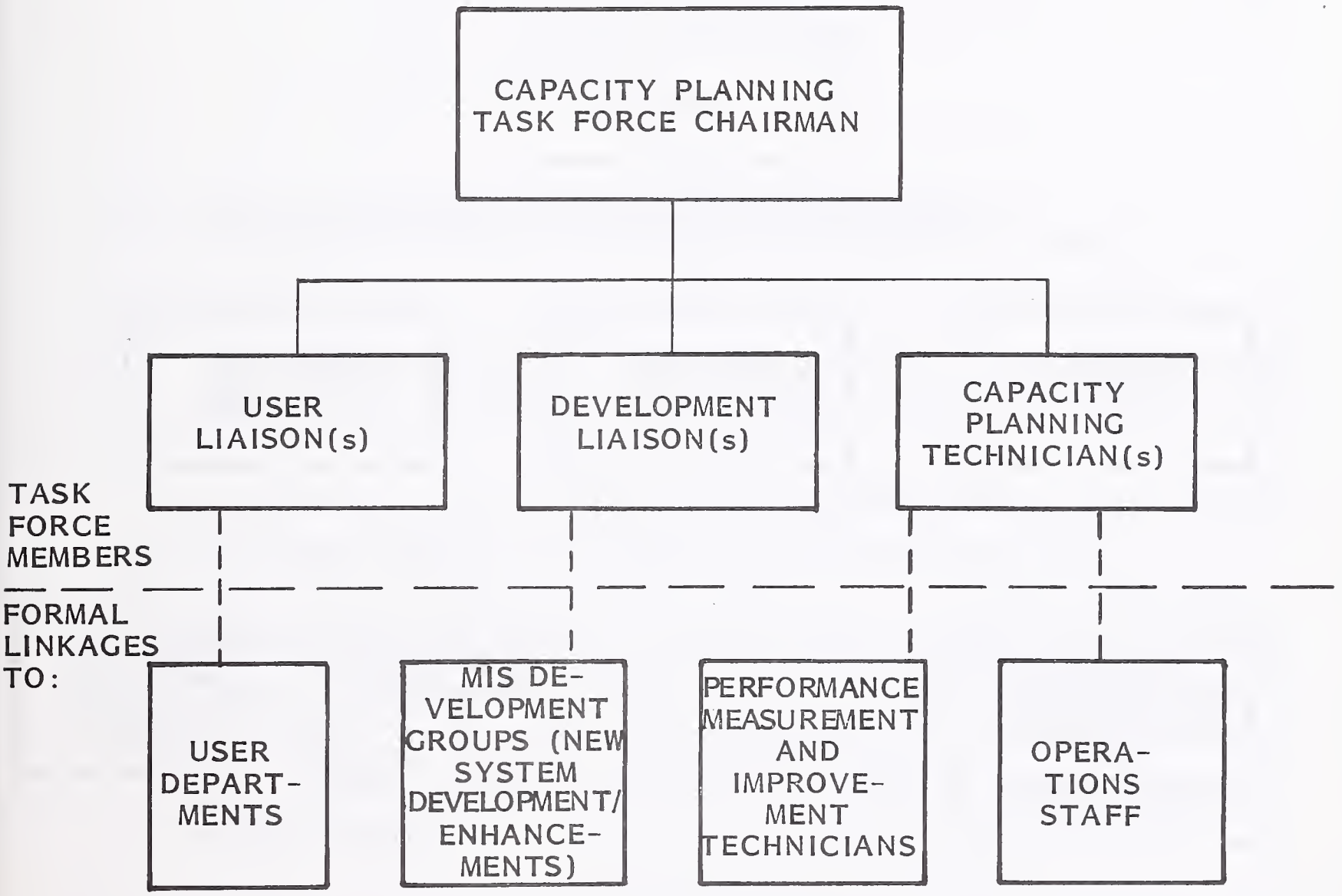
PERFORMANCE MEASUREMENT AND CAPACITY PLANNING COMPONENTS	EXTENT OF KNOWLEDGE REQUIRED IN				
	HARDWARE	SYSTEMS SOFTWARE	PARTICULAR APPLICATIONS SYSTEMS	ORGANI-ZATIONAL GOALS AND FUNCTIONS	GENERAL MANAGEMENT CONTROL AND TECHNIQUES
PROJECTING CAPACITY REQUIREMENTS	4	3	4	3	1
TRANSLATING BUSINESS NEEDS INTO COMPUTER WORKLOADS	1	2	5	5	5
COMPARING ACHIEVEMENTS TO STANDARDS	1	2	5	5	3
TIMING AND SCHEDULING THE SYSTEM	5	5	3	1	1
SETTING PERFORMANCE STANDARDS	1	3	5	5	5
MEASURING PERFOR-MANCE	3	5	2	1	1

KEY: EXTENT OF KNOWLEDGE REQUIRED – 5 = HIGH, 1 = LOW

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT VI-4

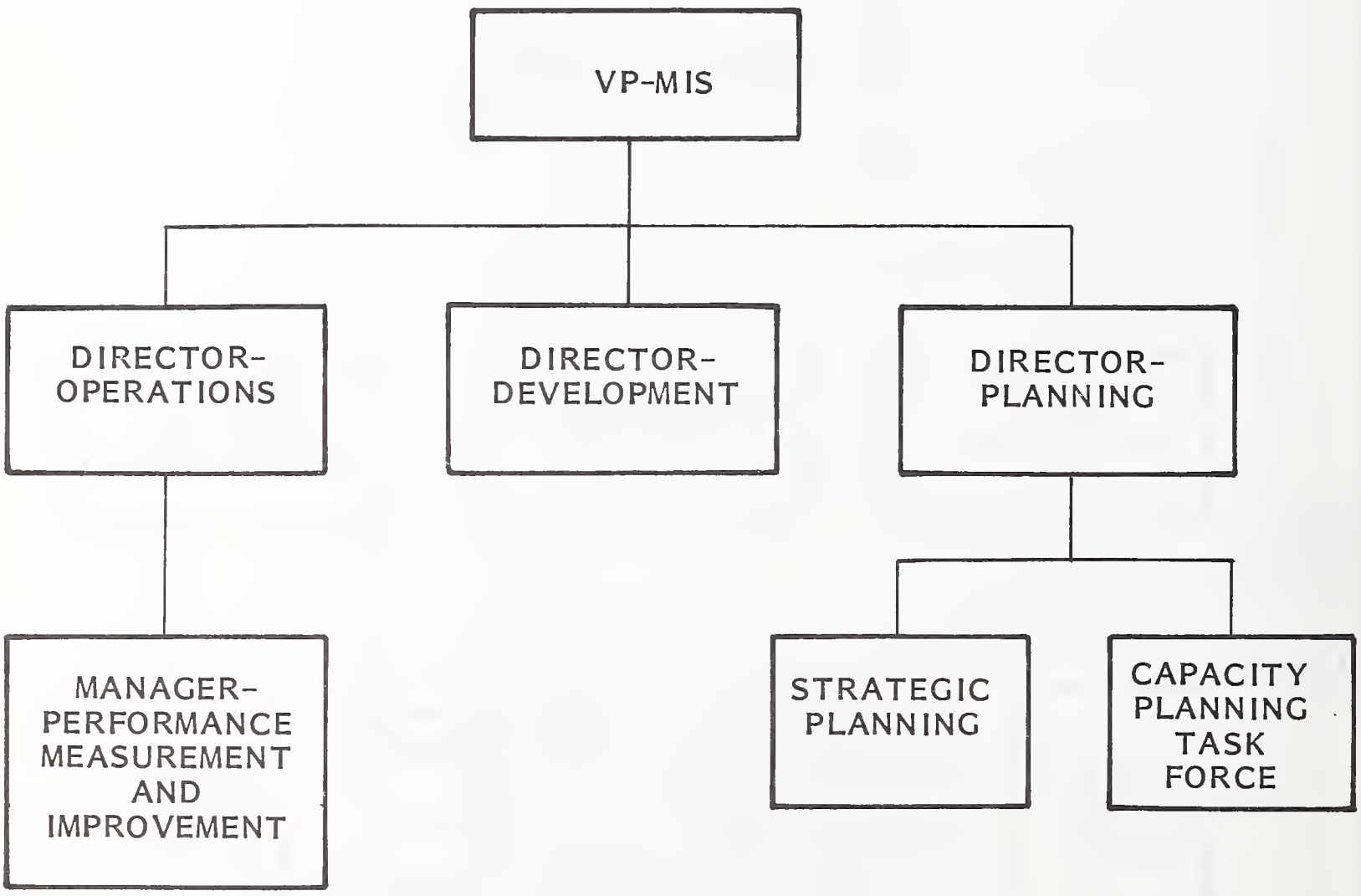
CAPACITY PLANNING: FUNCTIONAL RELATIONSHIPS



©1981 by INPUT. Reproduction Prohibited.

EXHIBIT VI-5

RECOMMENDED STRUCTURE



©1981 by INPUT. Reproduction Prohibited.

- Ensure intra-MIS coordination: MIS management should ensure that the development unit of MIS keeps operations informed of all its activities that would affect workload, whether new systems or major modifications.

  - The capacity planning task force can provide a forum for this activity.

  - Whatever life cycle development methodology is employed, there should be key checkpoints early in the design process for estimating workload.

    . Newer methodologies, such as BEST/1 and CRYSTAL from BGS Systems, will permit design-based metrics to be converted into workload estimates.

C. IDENTIFYING USER INTENTIONS AND SATISFACTION

- Learn users' business plans: Show top management that MIS needs to know user plans early so that data processing implications can be identified.

  - The MIS function must learn how to look at business plans from the users' viewpoints, even more in the future than in the past.

- Identify critical response times: Not all respose time requirements are equally important. Learn which ones really are critical from a dollars and cents, as well as an internal politics, standpoint; and learn how to diplomatically ensure that this point of view becomes part of the decision-making and priority-setting processes.

- Contain "what ifs": Decision support systems can be highly useful applications but can stop data processing dead in the water if they get out of control. Consider the following alternatives to true real-time interactive systems.

  - Dedicated minicomputers with an extracted data base of company data.

©1981 by INPUT. Reproduction Prohibited.

- Overnight, or at least delayed, turnaround.

- An outside timesharing service.

- The first two options are good entry approaches to set the terms of supply; the latter can be a form of load-shedding.

- Provide understandable reports to users: Performance reporting to users should be straightforward and results-oriented. Eliminate data processing jargon. Think about what the user is really interested in and report that.

  - This may take a bit of initial effort. However, in many cases MIS management will find itself better informed also.

- Establish an MIS "report card": MIS will regularly report its perception of planned versus actual service to users. Have users do the same. The MIS department may discover some communications problems at the least, and perhaps radically different perceptions of reality.

D. TACTICAL RECOMMENDATIONS

- Plan workload shedding: No one can be consistently successful in planning. Therefore, MIS management should have contingency plans for dealing with excess workloads (assuming that the easy way out, buying more equipment, is not available). This can take several forms:

  - Transfer prime-time batch to overnight.

  - Lengthen response time, using the following criteria:

    . Least dollar impact.

©1981 by INPUT. Reproduction Prohibited.

  - . Largest job.
  - . Weakest sponsor.
- Transfer work to minicomputers.
- Use commercial timesharing.
- Send work out of house (e.g., to a service bureau run by a disaster recovery service).

- Retain deep tactical capacity reserves: In order to keep a margin for the unexpected, retain some slack in the system. The credit MIS management thinks it is getting for postponing equipment purchases may actually be quite small (top management may not believe its claims). Whatever credit is gained by running a tight ship will be nothing compared to the problems caused by a capacity crisis. Examples of discreetly established reserves include:
  - Keeping marginal (sheddable) batch jobs in prime time.
  - Deemphasizing routine fine tuning.
  - Not improving service beyond levels contracted for.
  - Having stand-by arrangements with hardware monitor consultants in order to provide extra tuning.
  - Targeting discrete functions for rapid removal to minicomputers.
- Use good tools: Make sure that suitable tools are available (and used).
  - Everyone should consider acquiring a general-purpose software monitor. Internally processed RMF data may be too unwieldy.

©1981 by INPUT. Reproduction Prohibited.

- Capacity planning tools are a must for those who have the factual base and staff to support them.

- Tools will continue to improve, but if a tool is worthwhile now, don't delay action in the hopes that a better one will come along.

- Never improve service unilaterally: If the service improvement is unneeded and unexpected, the MIS department will receive little credit.

- More importantly, the higher level of service will become the new "standard" and it will not be possible to slip back to the old "adequate" service level.

©1981 by INPUT. Reproduction Prohibited.

APPENDIX A: INTERVIEW SAMPLE AND METHODOLOGY

APPENDIX A: INTERVIEW SAMPLE AND METHODOLOGY

- Thirty-five data processing installations with at least the equivalent of a 370/158 were interviewed.

  - The profile of interviewed installations is as follows:

    . The processing power of 15 installations was less than a 3033.

    . The remaining 20 had the equivalent of a 3033 or larger.

    . The smallest configuration was somewhat larger in power than a 370/158-3.

    . The largest installation had the equivalent of five 3033s.

    . Configurations were sized according to CPU ratings in thousands of operations per second (KOPS).

  - Interviewees ranged in position and responsibilities from senior technician to executive vice president.

    . Multiple interviews were held in several installations.

  - Companies across a wide range of industry groups were interviewed.

©1981 by INPUT. Reproduction Prohibited.

- The sample was nationwide.

- Nine interviews were held in person at the respondent's installation; the remainder were held by telephone.

- Eight vendors were interviewed.

  - They included leading hardware, software, and professional services firms.

  - Two interviews were held in person and the remainder were conducted by telephone.

©1981 by INPUT. Reproduction Prohibited.

APPENDIX B: USER QUESTIONNAIRE

APPENDIX B: USER QUESTIONNAIRE

1. Please describe what your organization is now doing in each of the following:

COMPUTER SYSTEMS PERFORMANCE MEASUREMENT

_____

_____

COMPUTER SYSTEM OPTIMIZATION

_____

_____

CAPACITY PLANNING

_____

_____

©1981 by INPUT. Reproduction Prohibited.

2a. So that I have an overview of your operations, tell me the major hardware and software you are using now (1981) and whether there have been any significant changes in the past year or if any are expected next year (1982).

RESOURCES	1981	1982	BUDGET ($ MILLION)
Hardware			$_____
CPU (model #)	____	____	
Disks (spindles)	____	____	
Terminals (#)	____	____	
Software			$_____
Op. Sys.	____	____	
(Data Base) DBMS	____	____	
Commun. Monitor	____	____	
Other	____	____	
Personnel (professional)	____	____	$_____
TOTAL			$_____

2b. What portion of the above are under the direct control and responsibility of the data processing department?

_____%

Describe user operated and distributed data processing hardware.

_____

_____

_____

2c. How large is your performance measurement and capacity planning staff?

©1981 by INPUT. Reproduction Prohibited.

2d. What rate of hardware expansion do you expect over the next five years?

_____

_____

_____

3a. How important is computer system performance measurement to the management of your computer operations? (5 = High, 3 = Medium, 1 = Low)

- Why?

- How important was it three years ago?

- Why?

3b. If a chargeback system is used:

- At what level does control exist (job, task, etc.)?

_____

- What is used in the pricing algorithm?
  - CPU.
  - I/O usage (EXCP's).
  - Class.
  - Priority.
  - Other.

- What problems do you have and how do you plan to alleviate them?

_____

_____

_____

_____

3c. Do any of the performance measurement software tools:

- Use graphics? YES ( ) NO ( )
- Operate in real time? YES ( ) NO ( )
- Future plans for graphics/real time tools? YES ( ) NO ( )

©1981 by INPUT. Reproduction Prohibited.

3d. The following are components of performance measurement and improvement. What are you doing now in each area (if computerized, the source of hardware or software) and what are your future plans (and timeframe)?

	BEING DONE	DESCRIPTION/SOURCE	IMPOR-TANCE*	SATIS-FACTION*	PLANS/YR.	REASONS/ COMMENTS
CPU Utilization						
Device Utilization						
Activity Measurement (e.g., Channels)						
System Utilization						
Throughput Measurement						
Direct Access Device Optimization						
Job Accounting						
Chargeback						
Other						

*5 = High; 3 = Medium; 1 = Low

©1981 by INPUT. Reproduction Prohibited.

3e. How much does the use of these tools increase your:

	THROUGHPUT	RESPONSE TIME
• Percent improvement	_____	_____
- Variance in estimate (+/-)	_____	_____
- Basis for estimate	_____	_____
• Additional improvement possible (%)	_____	_____
- Rationale	_____	_____

©1981 by INPUT. Reproduction Prohibited.

3f. Are you aware of any other hardware or software performance measurement packages?

PACKAGE NAME	SOURCE OF KNOWLEDGE	OPINION

3g. What is your biggest unmet need?

4a. How do you plan your hardware changes (additions, upgrades) now?

- What is the general process?

- Who is responsible?

4b. What software tools do you use?

©1981 by INPUT. Reproduction Prohibited.

4c. Are you aware of any software packages for projecting hardware requirement?

PACKAGE NAME	SOURCE OF KNOWLEDGE	OPINION

4d. How accurate has your projecting been, i.e., how close (in %) are your 6-12 month estimates? Why? Has it improved over time?

©1981 by INPUT. Reproduction Prohibited.

4e. Is this margin of error satisfactory? Why? What have you done to improve it?

_____

_____

_____

_____

_____

_____

_____

5a. We would like to explore the kinds of functions that would be most useful to you in projecting your hardware requirements. In general, what level of accuracy would you like to have the further you get into the future? What level are you now attaining? Express as a percent variation.

	VARIANCE (%, + OR -)	
TIME INTO FUTURE	TARGET	PRESENT
1 mo.	_____	_____
3 mos.	_____	_____
6 mos.	_____	_____
1 yr.	_____	_____
1½ yrs.	_____	_____
2 yrs.	_____	_____
3 yrs.	_____	_____
5 yrs.	_____	_____
Max.= _____	_____	_____

©1981 by INPUT. Reproduction Prohibited.

5b. Of the following functions involved in projecting hardware requirements, how do you deal with these now and how important is the function, how satisfied are you with what you're doing now and what are your plans for change?

	BEING DONE	DESCRIPTION	IMPORTANCE	SATISFACTION	PLANS
Hardware Projections					
CPU	____	_____	____	____	_____
Direct Access Devices	____	_____	____	____	_____
Terminals	____	_____	____	____	_____
Communications (Lines, controllers)	____	_____	____	____	_____
Trending/Methodology					
Straight Line	____	_____	____	____	_____
Other	____	_____	____	____	_____
Seasonality Factor	____	_____	____	____	_____
User Demand Estimates					
Percent Changes	____	_____	____	____	_____
In User Terms (e.g., Sales into transactions)	____	_____	____	____	_____
Output Types					
Graphics	____	_____	____	____	_____
Interactive "what ifs"	____	_____	____	____	_____
Projections By User Dept.	____	_____	____	____	_____

* 5 = High; 3 = Medium; 1 = Low

©1981 by INPUT. Reproduction Prohibited.

6a. What kinds of performance measurement software tools that you don't have now are you looking to vendors to supply?

_____

_____

_____

6b. Do these exist to your knowledge?
YES ( ) NO ( )

- If yes, what are they?

_____

_____

- If no, what will you do in the meantime?
( ) Nothing. ( ) Do it yourself.

7. What do you see as the overall trends in computer systems measurement and capacity planning over the next five years?

8. What impact on computer systems measurement and capacity planning do you expect from such specific events as:

- Falling hardware prices?

- Standalone, user operated systems?

- Distributed data processing?

©1981 by INPUT. Reproduction Prohibited.

APPENDIX C: VENDOR QUESTIONNAIRE

APPENDIX C: VENDOR QUESTIONNAIRE

1. How effectively do data processing installations use current performance measurement and capacity planning methodologies and products?

2. What do data processing installations need most?

3. How do you see current products changing?

4. Do you see a trend toward the integration of different products?

5. What is your company doing to make performance measurement or capacity planning more effective?

6. What do you see as the overall trends in computer systems measurement and capacity planning over the next five years?

7. What impact do you expect from such specific events as:

   - Falling hardware prices?
   - Standalone, user operated systems?
   - Distributed data processing?

©1981 by INPUT. Reproduction Prohibited.

APPENDIX D: PERFORMANCE MEASUREMENT AND CAPACITY PLANNING TOOLS

APPENDIX D: PERFORMANCE MEASUREMENT AND CAPACITY PLANNING TOOLS

- In the course of this study, information on a number of performance measurement, scheduling, and capacity planning software tools was accumulated.

- The lists shown in Exhibits D-1 through D-4 are not exhaustive but illustrate the large number of tools available (except in capacity planning), their varying prices, number of users, and ages. No single reference source appears to have a complete list; in part, this is because new products are constantly appearing while older, less successful products become inactive.

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT D-1

MEASUREMENT PRODUCTS - BATCH MONITORS (PARTIAL LIST)

NAME	VENDOR	PRICE ($ THOUSAND)	NUMBER INSTALLED	YEAR INTRODUCED
ALERT	NCR COMTEN	8.9-14	95	1974
CMF	BOOLE & BABBAGE	21	250	1978
EPILOG	CANDLE	15	-	-
4-TUNE	CAPEX	9.3	-	-
IMPROVE/CICS	INSAC	10	-	1979
IMPROVE/MON	INSAC	9	-	-
MANAGE/IMS	CAPEX	9.6	-	1978
IUPs, e.g., GTFPARS	IBM	RENTAL	-	-
MARKETING SUPPORT PRODUCTS	IBM	-	-	-
PLAN IV	CAPEX	6.5-15	225	1975
QCM	DUQUESNE	12-44	100	1971
RTA/CICS	CANDLE	5	-	-
SARA III & IV	BOEING	6.8-8	90	1974
SPM	DUQUESNE	12-24	120	1971
TSO/MON	MORINO	13.4	160	1976
VS/INSIGHT	UNIVERSAL	165/MO	15	1976
CAPTURE/MVS	BGS	6.5	25	1978

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT D-2

MEASUREMENT PRODUCTS - ON-LINE MONITORS (PARTIAL LIST)

NAME	VENDORS	PRICE ($ THOUSAND)	NUMBER INSTALLED	YEAR INTRODUCED
CICS/INFORM	COMMUNICATIONS SOFTWARE AIDS	-	-	-
CONTROL/IMS REALTIME	BOOLE & BABBAGE	13	100	1978
DEXAN	CANDLE	5	-	-
EXHIBIT	EXPERT SYSTEM PROGRAMMING	10	-	-
EXPLORE/DISCOVER	GOAL SYSTEM	3.6-12	200	1976
IMPROVE/RT	INSAC	6	-	-
INSYD	LABYRINTH SYSTEMS	4.5	-	-
LOOK	ADR	6-32.6	800	1975
OMEGAMON	CANDLE	15	75	1976
OMEGAMON/CICS	CANDLE	15	-	-
RESOLVE	BOOLE & BABBAGE	6-18	300	1975
SMT	VALUE	75-8.5	-	-
SPI	DUQUESNE	6-24	-	-
TSAII	TOTAL SYSTEMS	4.9	-	-

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT D-3

MEASUREMENT PRODUCTS - SCHEDULERS (PARTIAL LIST)

NAME	VENDOR	PRICE ($ THOUSAND)	NUMBER INSTALLED	YEAR INTRODUCED
APEX	JOHNSON	32	-	1978
CSAR	SOFTWARE CONCEPTS	9.5 BATCH 17.5-24.5 ON-LINE	-	-
SYSTEM III- CPU SCHEDULER AND DATA CENTER SCHEDULER	VALUE	12-30	200	1969
ON-LINE DATA CENTER MANAGEMENT SYSTEMS	VALUE	49-OS/VS 56-MVS	-	-
UCC 7	UNIVERSITY COMPUTING	47.5	-	-
DATA CENTER SCHEDULER	SOFTWARE MODULE MARKETING	6-8	15	1978
DIMENSION V	SDA PRODUCTS	35-60	20	1977
SCHEDULER	SYSTEMATICS	24	10	1978
DCMS	PRODUCTIVITY SOFTWARE	45	8	1980

©1981 by INPUT. Reproduction Prohibited.

EXHIBIT D-4

CAPACITY PLANNING PACKAGES

NAME	VENDOR	PRICE ($ THOUSAND)	NUMBER INSTALLED	YEAR INTRODUCED
BEST/I	BGS	19-24.5	150	1978
QUESTOR	PERFORMANCE SYSTEMS/ BOOLE & BABBAGE	-	NEW	1980?
SNAPSHOT	IBM	MARKETING USE ONLY	-	-

©1981 by INPUT. Reproduction Prohibited.